march 1957

nlgi spokesman

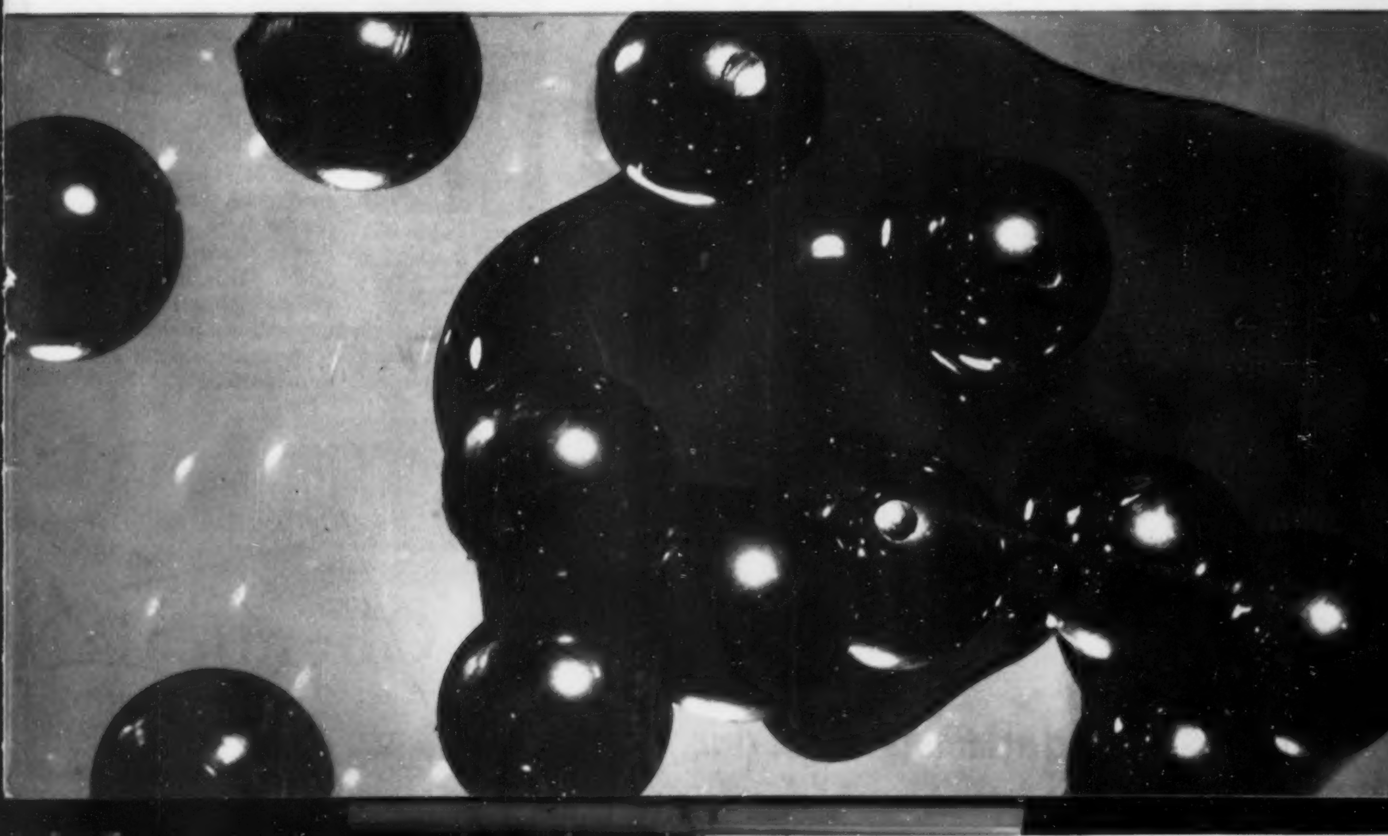
journal of the national lubricating grease institute

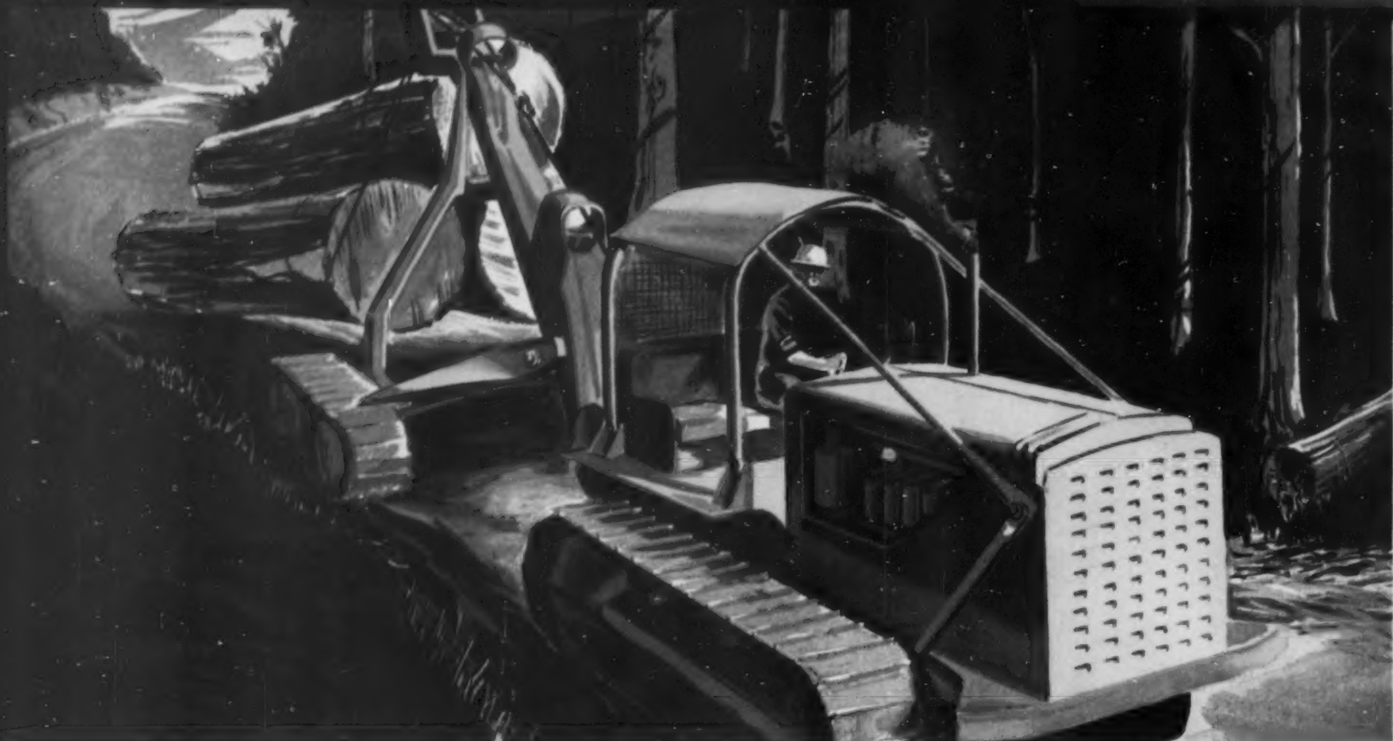
Problems Associated with Grease Lubrication of High Speed High Temperature Bearings
By HEINZ HANAU

Influence of Base Oil Characteristics on Performance of Antifriction Bearing Greases
By H. A. WOODS

Four-Point Program to Cut Highway Accidents
By A. E. SPOTTKE

NLGI SPOKESMAN Twentieth Anniversary





SUBSTANTIAL SAVINGS in downtime and maintenance costs have been experienced by many users of estersil greases in heavy-duty equipment.

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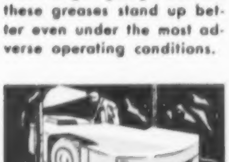
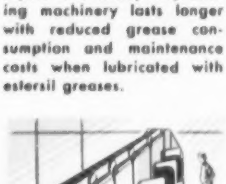


COAL MINE OPERATORS report that heavy-duty mining machinery lasts longer with reduced grease consumption and maintenance costs when lubricated with estersil greases.



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2. Superior oxidation stability—Estersil greases are almost as stable as their base oils and require no antioxidants under most service conditions.

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Procurement Committee

The committee for procurement of technical papers for publication in the NLGI SPOKESMAN has been reorganized and the current membership is as follows:

C. J. Boner, Chairman, Battenfeld Grease & Oil Corp.

J. L. Dreher, Vice-Chairman, California Research Corp.

S. L. Cosgrove, Battelle Memorial Institute.

W. F. Luckenbach, Foote Mineral Company.

This group, an intergal part of the Technical Committee, is actively engaged in obtaining papers of interest which will improve the service to the industry in reporting via the SPOKESMAN.

New NLGI Members

Five new members have been welcomed recently—they have joined the National Lubricating Grease Institute since the first of the year and include:

Bell-Ray, Inc., of Madison, New Jersey in an Active capacity . . .

Trabon Engineering corporation of Solon, Ohio in an Associate capacity . . .

American Lithium Institute, Princeton, New Jersey in a Technical capacity and . . .

Cooperative Grange League and Federation, Ithaca, New York in a Marketing capacity.

Inland Testing Laboratories, Morton Grove, Illinois in a Technical capacity.

Special new member feature articles about these organizations and their NLGI representatives will be featured in later issues of the SPOKESMAN. These additions bring Institute membership totals to an all-time high.

Board of Directors Meets

The Board of Directors of the NLGI met Thursday, February 28, 1957, at the Sheraton-Cadillac hotel, at the conclusion of the API-SAE session with the automotive industry. Items discussed included a progress report of the NLGI movie, "Grease, the Magic Film" and the proposed industry survey of lubricating grease production. Reports will be made later through the pages of this journal.

Readily Available

Reprints of features presented in the NLGI SPOKESMAN are readily available to firms wanting to purchase articles of special interest. Page forms are kept for three months and many organizations make up their own booklets or brochures, complete with company advertising, using SPOKESMAN features. Cost is low since typesetting and page layout has already been completed.

SERVICE AIDS OFFERED BY NLGI

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- **WHEEL BEARING MANUAL—"Recommended Practices for Lubricating Automotive Front Wheel Bearings." More than 90,000 copies of this booklet have been distributed throughout the world. Just fifteen cents a copy with quantity discounts—company imprint can be arranged.**

- **NLGI SPOKESMAN — Bound Volume XIX, covering past issues from April, 1955 through March, 1956. An excellent reference source, sturdily bound in a handsome green cover. $7.00 each, plus postage.**

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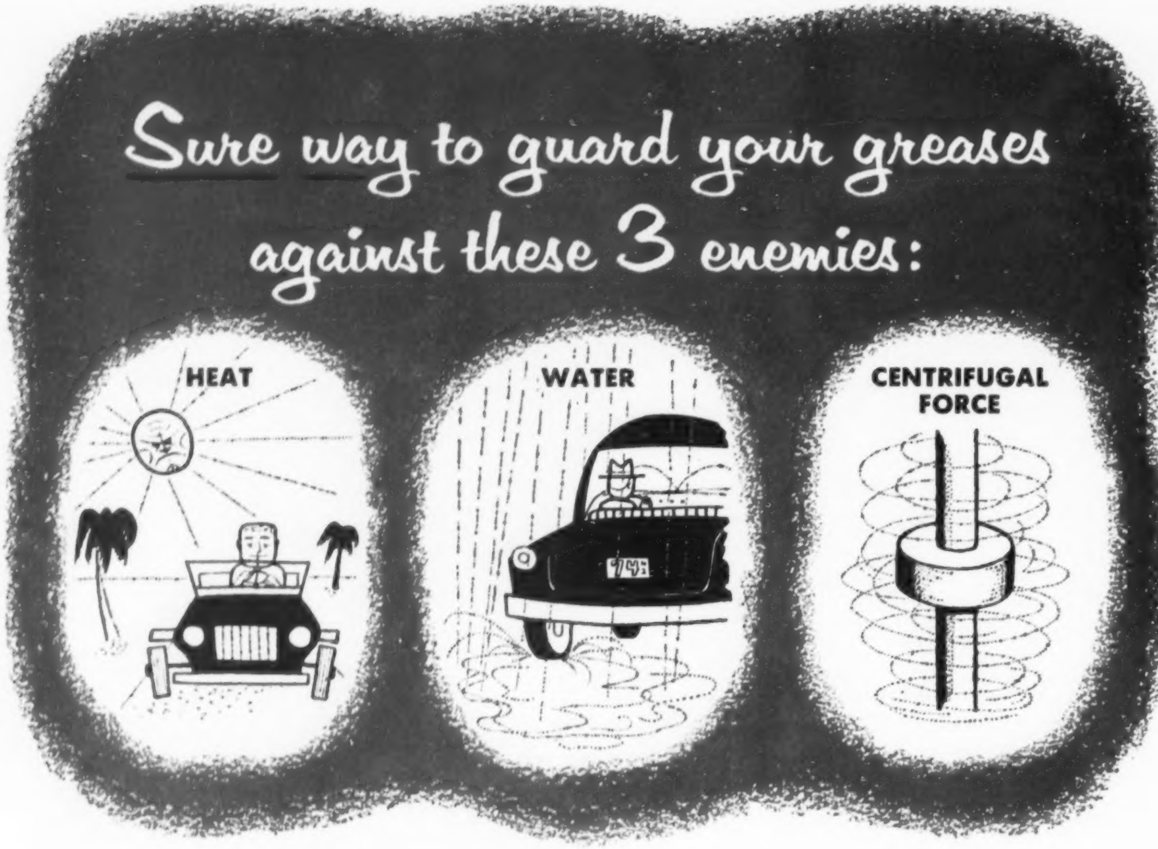

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THE PRESIDENT'S PAGE

By J. W. LANE
NLGI
President

REFLECTIONS OF NLGI MEMBERSHIP

As of the moment National Lubricating Grease Institute numbers some 156 members in all categories of membership, drawn not only from the United States but from many foreign countries as well. This figure should continue to grow, providing we do our part. This calls for constant watchfulness in devising and carrying out programs that can result in demonstrable benefits to the lubricating grease industry. The whole idea is one of "what we do," rather than one of "what we are." Membership solicitation is easier and more fruitful when we can point to things accomplished.

A growing membership indicates a thriving and progressing organization. While there are undoubtedly fairly definite limits to our growth within the confines of our present constitution, I feel it safe to predict that such limits are not yet being strained and that we should continue to evidence a satisfactory growth.

The Institute profits greatly from every new member added to the roster. The first, and to me the most important benefit, is that new blood, with new thoughts and fresh approaches to old problems, is introduced. This keeps us from growing stale, diversifies our interests and broadens our viewpoint. Every new member is really a challenge of sorts—we are put on the spot, as it were, to convince him that he has not bought "a pig in a poke." Second, there is the added income that lets us improve and expand our activities. This is always important to a non-profit organization such as NLGI.

We attract new members only by giving service. We can do this as an organization, as members, and as individuals, if we will bring to every NLGI activity constructive thinking and sincere cooperation, plus enthusiasm for the job to be done.

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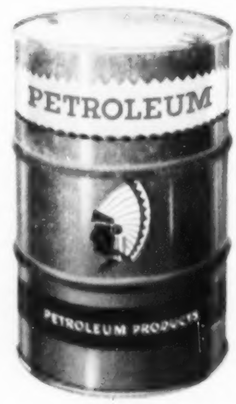

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Volume XX MARCH, 1957 Number 12

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Published Monthly by National Lubricating Grease Institute, T W. MILLER, Editor; JOAN SWARTHOUT, Assistant Editor, 4638 J. C. Nichols Parkway, Kansas City 12, Missouri. Telephone: VAlentine 1-6771. 1 Year Subscription, $2.50. 1 Year Subscription (Foreign), $4.00.

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IN THIS ISSUE

THE COVER

The pool of lubricant and flattened bearings illustrates the four-ball extreme-pressure lubricant experiment for evaluating high speed high temperature gear lubricants. The experiment is started by rotating one bearing, under load, against three others. If the lubricant fails during the one minute rotation period, enough heat is generated to weld the balls together.

Urgent need for improved high speed high temperature greases to accommodate current and projected aircraft requirements is stressed by authors Hanau, Woods and Carmichael. MIL-G-25013 specification requires minimum bearing life of 500 hours at 450 F.

Photo courtesy Battelle Institute

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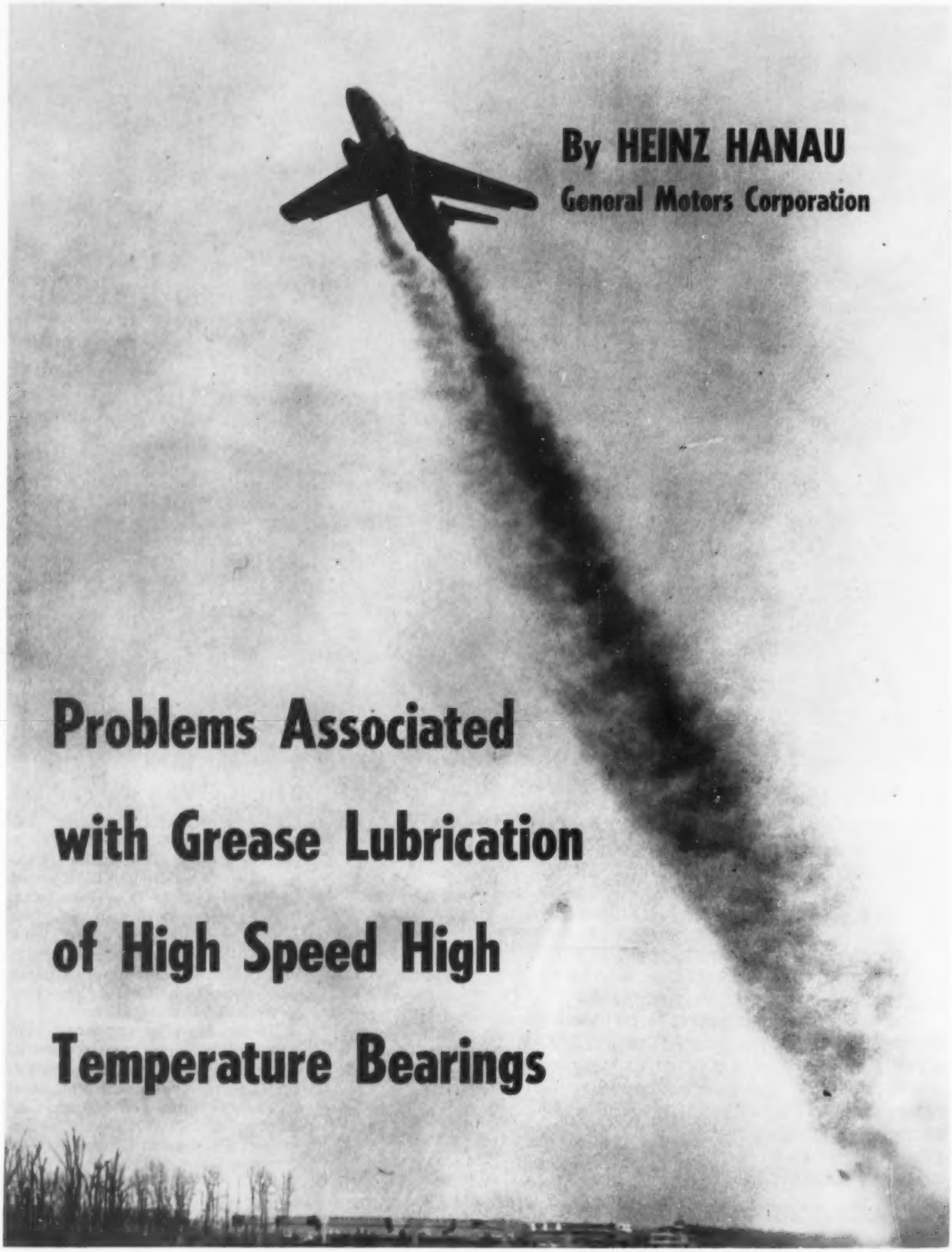


Problems Associated with Grease Lubrication of High Speed High Temperature Bearings

By HEINZ HANAU
General Motors Corporation

Official USAF Photo

Introduction

As BALL BEARING manufacturers, we have a very vital interest in the field of lubrication simply because we have found that without lubrication our bearings will not work satisfactorily.

Having established the fact that we must lubricate a ball bearing, we set about doing this with a minimum of extra bulk, weight and complexity, because our customers want and are accustomed to getting a product that will consume a minimum of weight and space in their equipment and requires a minimum of attention and service.

The bearing industry has been able to meet this requirement and is still doing so in the majority of industrial application fields by supplying a grease packed, shielded or sealed ball bearing of the type shown in figure 1.

A bearing of this type has speed, load, and temperature limitations which prevent its use above:

250,000 DN
250° F

for any appreciable operating life.

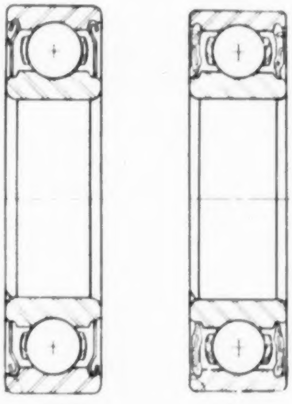


Figure 1

As speed, temperature and load requirements have increased, it has become more difficult to be able to furnish a grease lubricated ball bearing. Therefore, an oil lubricated ball bearing must be used with its added bulk and complexity.

This is particularly true of equipment used in today's high speed aircraft an in future aircraft now being designed and developed.

Aircraft Equipment Requirements

The most stringent requirements from an over-all lubrication standpoint are imposed on the ball bearings employed in aircraft turbo accessory equipment.

Turbo accessories have many different functions and are being used in increasing quantity not only in airplanes but in ground equipment.

A typical operational aircraft and the type of turbo accessories it employs is shown in figure 2.

Hot compressor gases from the turbo jet engines are piped to various parts of the airplane, as shown schematically in figure 3, where they provide the power to drive the accessory turbines, thus eliminating bulky engine mounting of accessories.

The gas turbines used to drive this equipment produce their power, with any degree of efficiency, only at high speeds and high operating temperature levels.

Most turbo accessories are now forced to use some type of oil system to lubricate the ball bearings in order to achieve required service life at the speeds and temperatures involved.

In cases where grease lubrication is employed in this type of equipment, it is usually accomplished at the sacrifice of long service life or by frequent regreasing.

Figure 5 shows a typical refrigeration turbine installation using wick oil-mist systems. This type of equipment is now being used at 80,000-130,000 rpm on 10-15 mm bore bearings at temperatures up to 450° F with 250-500 hrs. service life.

A bearing mounting of the power turbine for an alternator drive or hydraulic pump drive is shown in figure 6. Speeds of 25,000 to 45,000 rpm at comparatively high loads on 20-30 mm bore bearings are encountered in today's units. In cases where the speeds exceed the 25,000 rpm range and the temperature is

Figure 2

Figure 3

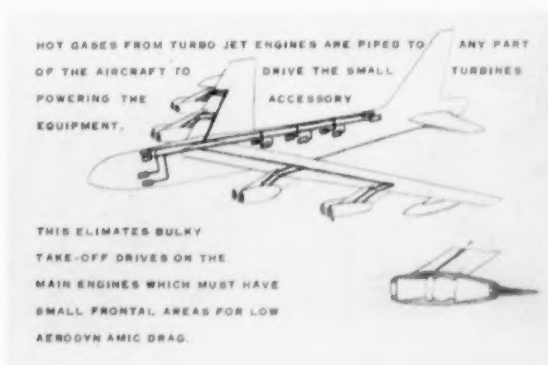
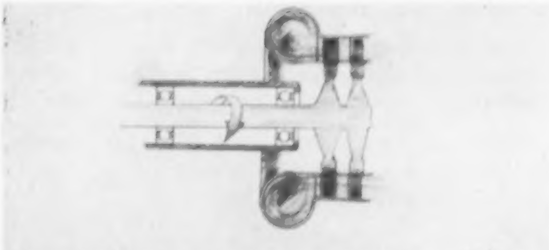
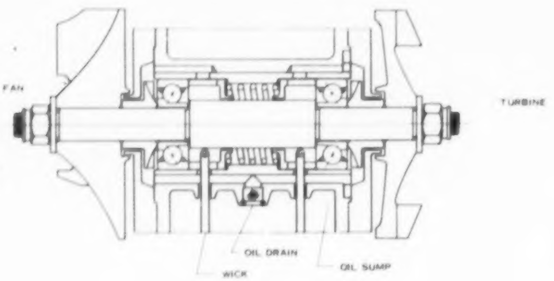


Figure 4



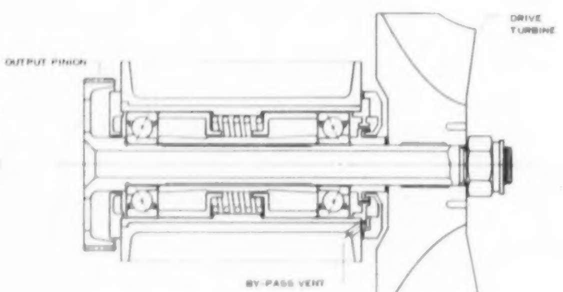
GAS TURBINES MUST BE OPERATED AT HIGH SPEED AND TEMPERATURE LEVEL TO GIVE EFFICIENT PERFORMANCE.

Figure 5



TYPICAL REFRIGERATION TURBINE INSTALLATION

Figure 6



TYPICAL BEARING MOUNTING FOR ALTERNATOR DRIVE POWER TURBINE

Figure 7

TYPICAL BEARING MOUNTING FOR JET ENGINE STARTER DRIVE TURBINE

much above 300° F, oil lubrication is generally employed.

The power turbine installation for a typical jet engine starter is shown on figure 7. Again both grease and oil lubrication is employed.

Bearings are subjected to high acceleration starts to 60,000 rpm on 20-30 mm bore size at high load and high temperature.

One of the main advantages of all the turbine driven accessories is their weight to horsepower ratio.

Only a minimum amount of weight can, therefore, be allocated to self-contained lubrication systems.

Grease lubrication of turbo accessory bearings would accomplish:

1. weight reduction
2. bulk reduction
3. Reduce sealing problem
4. reduce maintenance problem

This points out the very great need for a high speed, high temperature, high load carrying grease.

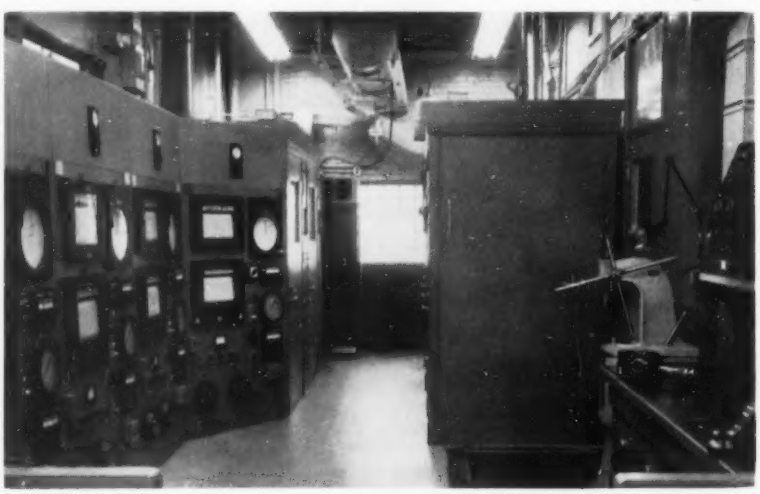
High Speed, High Temperature Program

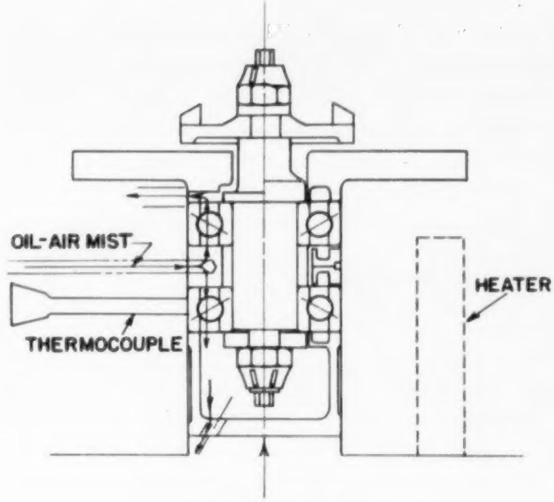
In order to meet the need for high speed, high temperature ball bearings in turbo accessory equipment, ND has started a development program with the following objectives:

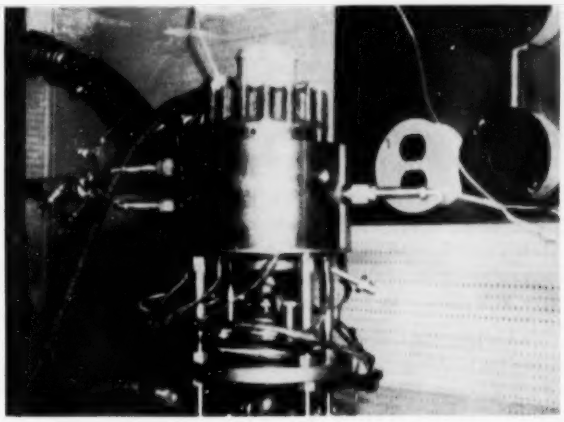
200,000 RPM
1,000° F
Moderate loading
1,000 hrs. life
2,000,000 DN

Ultimate goal; development of a unitized package consisting of shafts, bearings, lubricants and seals.

Figure 8







LEFT, Figure 9, High Speed Turbine Driven Bearing Tester. Testing is done on air turbines operating up to 130,000 rpm, 500° F. Figure 10 is External View of the Unit.

The steps to achieve these goals are:

1. to develop optimum ball bearing geometry for high speed operation.
2. develop high speed separators.
3. develop method of lubricant introduction.
4. evaluate lubricants.

A turbine laboratory with five fully instrumented test cells, as shown on figure 8, has been constructed and is now in operation.

Testing is done on air turbines, supported on both 10 and 20 mm ball bearings, capable of operation up to 130,000 rpm at temperatures up to 500° F. Pneumatic thrust loading is provided.

Figure 9 shows a schematic picture of the turbine driven test unit.

It is possible to record and measure:

1. Speed (Hewlitt Packard magnetic speed sensing device)
2. Temperature of outer rings
3. Temperature at various parts of the turbine shroud and housing
4. Air pressures
5. Vibration (panoramic oscilloscope)

Figure 10 shows the external view of the unit.

Additional test equipment is now under construction to raise the test conditions to 200,000 rpm and 1,000° F.

An inner ring temperature measuring device is now being developed in the laboratory that will record at speeds up to 200,000 RPM.

Present Developments

Testing has so far been confined to evaluating high

FIG. 11 is a 20 mm bore bearing with outer ring cage.

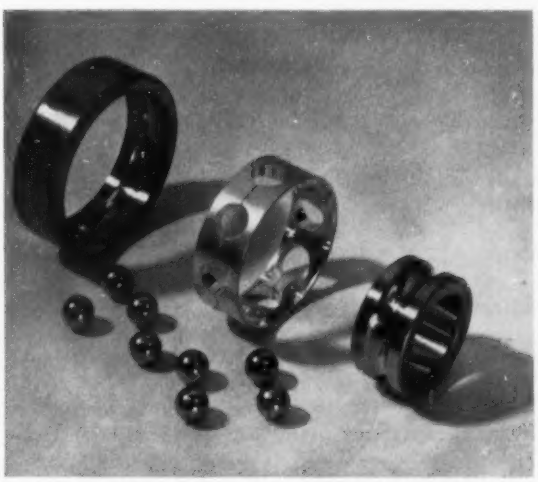
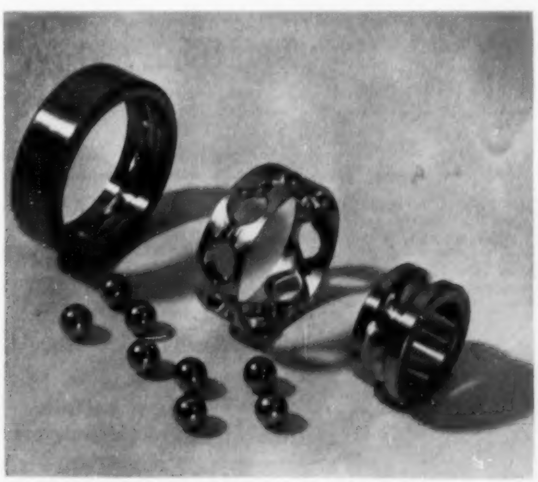


FIG. 12. Two piece outer ring riding cage grade A.



speed cages, limiting speeds of present bearing designs, grease testing and minimum oil consumption tests, all at room ambient temperature.

It has been found that outer ring riding cages will out perform inner ring riding cages with oil and especially with grease at high speed operation.

Figure 11 shows a 20 mm bore bearing with two-piece rivet assembled outer ring riding cage of S-Monel, and figure 12 a two-piece outer ring riding cage grade A phosphor bronze used in the laboratory for grease and oil testing.

Both bearing configurations have been operated for short periods of time at 90,000 rpm ($DN = 1.8 \times 106$) using aerosol lubrication, and both have been used in tests evaluating greases at 40,000 rpm.

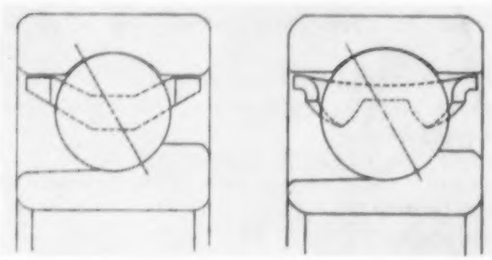


FIG. 13. This type bearing gives better performance, as shown by testing both in the laboratory and in the field. This "J" type employs a one-piece cage guided on the outer ring bore—successful at ultra high speed.

Testing both in the laboratory and in the field have shown that better performance can be obtained with the type of bearing shown on figure 13.

The bearing is known as the "J" type, employs a one-piece cage guided on the outer ring bore and has been made with both machined and pressed metal types of cages. It represents a successful bearing configuration of ultra high speed operation and is being employed in current laboratory research.

Grease test evaluation in our laboratories and field experience has so far been confined to testing different greases which has led to the following conclusions:

1. At $DN = 800{,}000$ very short grease life is obtained.
2. At temperatures above 350° F very short grease life is obtained.
3. A grease lubricated bearing is not able to carry the load which an oil lubricated bearing can carry particularly at high speeds.

Conclusion

Our high speed, high temperature program considers as one of its most important functions to make high speed, high temperature bearings work with grease lubrication.

We have operational test facilities for this purpose and have developed a test bearing for the job.

We have gained a certain knowledge of conventional bearing applications.

However, the science and actual mechanism of grease lubrication of ball bearings is only vaguely understood, particularly so in the high-speed field.

Up to now, investigations in this field have been hampered by lack of bearing designs and configurations capable of operating in the ultra high-speed range.

Recent developments in our laboratory have resulted in considerable progress in overcoming this deficiency.

I would like to stress the very urgent need for high-speed, high-temperature greases for current and projected military and civil aviation requirements.

It will require the concentrated efforts of your research facilities to develop the necessary greases for these applications.

We would heartily welcome the opportunity of utilizing our facilities in cooperating with you on such a program. ■

About the Author

HEINZ HANAU is supervisor, aircraft projects for General Motors corporation. He was born in Frankfurt, Germany and attended high school there and in England. His engineering education was started in Sweden and completed with a B.M.E. degree from Pratt Institute and an M.M.E. degree from New York University.

Hanau's professional activity has been centered almost exclusively around the aircraft industry: reciprocating engine analysis, helicopter transmission design, high speed gearing. He has been with the new departure division of GM since 1950 and as supervisor he is in charge of applying ball bearings to all types of aircraft products.

FUTURE MEETINGS of the Industry

MARCH, 1957

5-7 National Passenger Car, Body and Materials Meeting, Sheraton-Cadillac, Detroit, Michigan.

11-12 Illinois Petroleum Marketers Association (35th annual convention), Hotel Pere Marquette, Peoria, Ill.

14-16 Texas Oil Jobbers Association (annual convention), Rice Hotel, Houston.

19-21 Ohio Petroleum Marketers Association (Spring convention and trade exposition), Deshler-Hilton Hotel, Columbus.

20-22 National Production meeting and forum, Hotel Statler, Buffalo, N. Y.

20-22 API Division of Production (Southern District Meeting), Washington Youree & Captain Shreve Hotels, Shreveport.

25-27 Midwest Gas Association meeting, Hotel Nicollet, Minneapolis.

27-29 American Power Conference meeting, Sherman Hotel, Chicago.

28 National Industrial Conference Board (general session), Sheraton-Palace Hotel, San Francisco.

APRIL, 1957

2-5 National Aeronautic Meeting, Production Forum, and Aircraft Engineering Display, Hotel Commodore, New York.

7-12 American Chemical Society (131st national meeting), Miami, site unreported.

10-12 API Division of Production (Mid - Continent District meeting), Mayo Hotel, Tulsa.

15-17 American Society of Lubrication Engineers (12th annual meeting and exhibit), Sheraton-Cadillac Hotel, Detroit, Mich.

16-18 National Petroleum Association, Cleveland, Ohio.

18 National Industrial Conference Board (meeting of board), Waldorf - Astoria Hotel, New York City.

24-26 National Gasoline Association of America (36th annual convention), Rice Hotel, Houston.

24-26 API Division of Production (Rocky Mountain District meeting), Gladstone, Townsend & Henning Hotels, Casper, Wyo.

28-30 Independent Petroleum Association of America (midyear meeting), Buena Vista Hotel, Biloxi.

29-May 1 American Oil Chemists' Society (annual meeting), Roosevelt Hotel, New Orleans.

MAY, 1957

1-3 API Division of Production (Eastern District meeting), William Penn Hotel, Pittsburgh.

6-8 API Annual Pipe Line Conference, Cleveland Hotel, Cleveland.

6-8 API Lubrication Committee, Grand Hotel, Point Clear, Ala.

13-16 API Division of Refining (midyear meeting), Sheraton, Hotel, Philadelphia.

15-17 Fuel Oil Distributors Association of New Jersey (annual convention), Hotel Berkeley, Carteret, Asbury Park, N. J.

16-17 National Industrial Conference Board (general session), Waldorf - Astoria Hotel, New York City.

19-22 Texas Independent Producers & Royalty Owners Association (annual meeting), Galvez and Buccaneer Hotels, Galveston.

22-24 API Division of Production (Eastern District meeting), William Penn Hotel, Pittsburgh.

JUNE, 1957

2-7 Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

9-14 API Division of Production (midyear committee conference), Muehlebach Hotel, Kansas City.

10-12 Interstate Oil Compact Commission (midyear meeting), Canyon Hotel, Yellowstone National Park.

16-21 ASTM, Chalfonte-Haddon Hall, Atlantic City, N. J.

24-25 Michigan Gas Assn. meeting, Grand Hotel, Mackinac Island, Mich.

24-28 American Institute of Electrical Engineers (1957 Summer general meeting), Sharaton-Mt. Royal Hotel, Montreal.

SEPTEMBER, 1957

11-13 National Petroleum Association (55th annual meeting), Traymore Hotel, Atlantic City, N. Y.

22-24 Tenth Annual Meeting of the Independent Oil Compounders Association. Carter Hotel, Cleveland, Ohio.

30-Oct. 2 American Oil Chemists' Society (1957 Fall meeting), Netherland Plaza Hotel, Cincinnati.

OCTOBER, 1957

1-2 Texas Mid-Continent Oil & Gas Assn. (38th annual meeting), Texas Hotel, Fort Worth.

6-9 AIME (Petroleum Branch meeting), Dallas. Site unreported.

7-9 American Gas Assn. (annual convention), Kiel Auditorium, St. Louis.

28-30 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

Influence of Base Oil Characteristics on the Performance of

ANTIFRICTION BEARING GREASES

By H. A. WOODS
Shell Oil Company

ABEC-NLGI Bearing Performance Tester used in conducting bearing tests at 450F to 600F. Total watts used, 1500.

INTRODUCTION

As "LUBRICATION OF BALL BEARINGS" is a broad subject, and we are grease manufacturers, we thought that we should restrict our remarks to a brief review of some of our experiences with the various types of oils used in antifriction bearing greases. We wish to emphasize that the importance of the thickener is not being overlooked in connection with our discussion of the oil content. The thickener often has a catalytic pro-oxidant effect. Furthermore the structural integrity of the thickener may be destroyed by oxidation products of the oil itself. Needless to say, the melting point of the thickener has a profound influence on high temperature performance.

Present specification requirements for antifriction bearing greases cover temperatures ranging from $-100°F$ to $450°F$. In addition, some critical needs exist for grease lubrication at $600°F$ and temperatures as high as $700°F$ are under consideration. Mineral oils are suitable for use as the vehicle in the more moderate of these applications but synthetic oils are required for the extreme low temperature and extreme high temperature services.

In the low temperature grease applications, the viscosity of the oil content is of major importance because of its effect on bearing torque. Mineral oil greases are suitable for the temperature range of $-65°F$ to $225°F$ but it is well known that diesters and

ABSTRACT

The role of the fluid vehicle in the performance of antifriction bearing greases and base oil requirements for different temperature ranges are discussed. The relative influence of oil volatility and oxidation inhibitors is considered for high temperature applications. Mineral oils, esters, silicones, and fluorocarbons were among the fluids tested. The results presented show that well inhibited mineral oil and polyester type greases provide excellent service from about $-65°F$ to at least $300°F$. Diesters and low viscosity silicones are superior for use at extreme low temperatures and high molecular weight silicones are the only fluids found suitable for use at temperatures over $400°F$. Fluids for satisfactory operation at temperatures above this level will require greater thermal stability, reduced volatility and, perhaps, more powerful oxidation inhibitors.

low viscosity silicones are more satisfactory for use at lower temperatures and at wider ranges, such as −100°F to 250°F, because of their low volatility and excellent temperature/viscosity characteristics. In contrast to this, oxidation stability is the main prerequisite for good high temperature performance, although volatility must not be overlooked. Because of the great importance of oxidation stability on bearing life, this property will be discussed first.

DISCUSSION

Oxidation Stability vs. Bearing Performance

During the past ten years, the requirements for high temperature bearing performance have increased considerably. This is illustrated by the change made in military specifications covering high temperature greases. In 1944, specification AN-G-5a required a minimum of 300 hours performance at 300°F. This was increased to a minimum of 600 hours at the same temperature when specification MIL-L-3545 was issued in 1951. In 1955, a great increase in performance was called for with the introduction of Air Force specification MIL-G-25013 (USAF) which requires a minimum of 500 hours at 450°F. All of these requirements were difficult to meet at the time of introduction.

The development of improved bearing greases progressed slowly at first because the only means of evaluation was in bearing rigs. These rigs were scarce and expensive and several tests were required for each grease because of the poor repeatability of the test. During this period, however, we learned of the great importance of oxidation stability on high temperature performance and subsequently developed three short tests which have proven useful for screening greases for this service. These consist of an oxygen absorption test, a thin film oxidation test, and a short bearing test. All correlate well with high temperature performance. In this connection, it is common knowledge that the ASTM bomb oxidation test is reliable for predicting the shelf storage life of grease but does not relate directly with bearing performance.

(1) Oxygen Absorption Test

The "oxygen absorption test" is a modification of the conventional Dornte oxidation test* in which oxygen is bubbled through the test liquid at 300° F in the presence of iron wire catalyst until predetermined volumes of the gas are absorbed by the medium being tested. Instead of evaluating straight oils, with and without oxidation inhibitors, 1.0% of the grease thickener was included to simulate the catalytic effect that most grease thickeners have on oxidation stability. Typical test results obtained with mineral oil greases and an indication of the relation that exists between oxygen absorption and bearing performance are presented in Table 1.

TABLE 1

Oxygen Absorption vs. Bearing Performance

	Inhibitor Content, %w		
	None	(1.0 "*A*") (1.0 "*B*")	(1.0 "*A*") (1.0 "*C*")
1.0% *Li soap/oil blend*			
Time for 1500 ml 0_2 absorption, 300°F, hr.	4	75	200+
Li soap grease			
Performance at 250°F, hr.	304	1118	4695+

These results show that the addition of the combination of inhibitors "A" and "B" markedly reduced the rate of oxygen absorption in the Dornte test and increased the bearing performance of the grease. They also show that the combination of inhibitors "A" and "C" was still more effective in these respects. Correlation between oxygen absorption and bearing performance was excellent.

(2) Thin Film Oxidation Test

The second screening test was developed to give an indication of the structural and oxidation changes that occur when a thin film of grease is subjected to high temperatures. It also gives a quantitative measure of volatility. One gram of grease is spread uniformly in a depression, two inches in diameter and 0.188 inch deep, in a mild steel plate and subjected to the desired temperature for extended periods of time in a forced draft oven. Observations are made at 24 hour

*R. W. Dornte, Industrial and Engineering Chemistry, page 26, 1936.

OXYGEN absorption test apparatus used in evaluating oils. Oxygen is bubbled through test liquid at 300F.

Discussion of Woods Presentation By E. S. Carmichael On Page 20

intervals and the greases are rated according to changes in color, consistency, texture, weight loss and tendency for oil separation. This test is simple and has proven excellent for judging the effectiveness of various oxidation inhibitors. The results generally correlate with high temperature bearing performance. An example of the results obtained with mineral oil greases is shown in Figure 1.

(3) Short Term Bearing Test

The third screening test is an abbreviation of conventional high temperature bearing tests. Instead of running the bearings to failure, which often require several hundred hours, the test is terminated after 20 to 100 hours depending upon the temperature and grease being tested. At that point, the bearing is carefully inspected to determine the condition of the grease in regard to oxidation, consistency and oil separation. From these observations, the grease can be rated as being promising or unpromising for bearing service at the test temperature. Examples of the results obtained are shown in Figure 2.

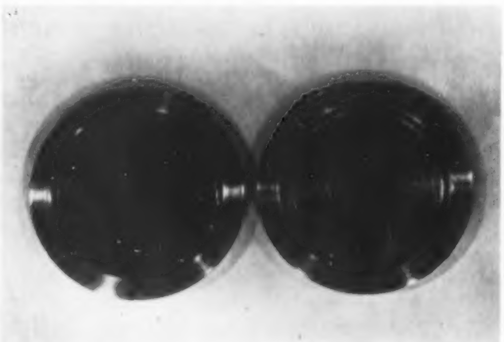


FIG. 1. Thin film oxidation test. Left plate is grease "A" plus high temperature inhibitor. Right, shelf storage.

These plates had been subjected to a temperature of 300°F for 20 hours and this short test quickly disclosed the relative oxidation stability of the greases. The same base grease was used in both tests but the inhibitor content differed. The grease on the left contained an effective high temperature inhibitor and is relatively unchanged. The grease on the right contained a very effective shelf storage inhibitor but it failed to provide good high temperature stability. These same two greases were used in the next screening test.

These tests were run for 100 hours at 300°F and 10,000 rpm. The relatively unchanged condition of the grease in the bearing on the left confirms that the high temperature inhibitor provides good stability against oxidation at high temperatures. Most of the grease in this bearing adhered to the shield when it was removed. The highly oxidized condition of the grease in the bearing on the right again shows that the shelf storage inhibitor furnishes little protection against high temperature oxidation. These results correlate well with bearing performance, as the stable grease provides five times the bearing life exhibited by the grease containing no high temperature inhibitor.

TABLE 2

Oil Component: Penn Bright Stock and Fractions

	Oil Vis, SSU at 100°F	Oil Vis, SSU at 210°F	Grease Performance* at 300°F, hr
Penn			
Bright Stock	2,441	152.0	489
0-10% Cut	402	57.2	. . .
10-50% Cut	799	76.2	180
50-78% Cut	2,726	156.2	1,007
22% Bottoms	24,915	705.0	423

*Navy tester, 204 K bearings

Volatility vs. Bearing Performance

The results of some brief studies of the effect of volatility on bearing performance may be of interest.

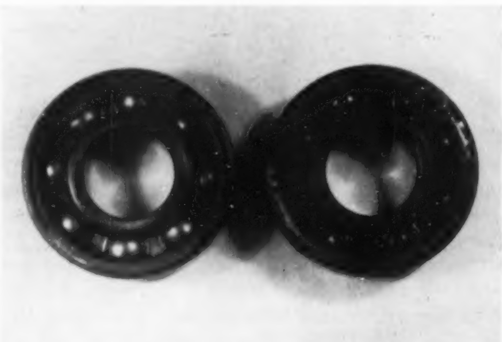


FIG. 2. Short bearing test. Left, grease "A" plus high temperature inhibitor. Right, shelf storage inhibitor.

Bearing tests were conducted with greases containing various oil fractions obtained from the distillation of Pennsylvania bright stock in the laboratory molecular still. The results obtained are shown in Table 2.

The first 10% cut was not tested in grease because of high volatility. The poor bearing performance obtained with grease containing the 10 to 50% cut was apparently due to high volatility. In contrast, grease containing the 50 to 78% cut was excellent. As the 22% residue from the distillation was fluid, tests were made to determine if a further improvement in performance could be obtained using this less volatile oil. The results were mediocre, however, owing to the formation of resinous oxidation products which jammed the bearing and prevented starting following the 2.5 hour cooling period. This illustrates the improvement in performance that can be made through the use of carefully selected lube oil fractions, thereby reducing volatility by eliminating the light ends and improving oxidation stability by eliminating the less stable bottoms.

TABLE 3

Evaluation of Synthetic Oils

	Phenylmethyl-polysiloxane	*Chlorinated Phenylmethyl-polysiloxane*	*Polyester*	*Fluorocarbon Oil*
ASTM Evap, 400°F, %w	2.2	3.2	20.7	85.6
ASTM Evap, 400°F, %w				
Original	77.5	55.8	55.1	705
After 24 hr at 450°F	86.6	(gell)	(solid)	
48 hr at 450°F	91.0			

Extreme High Temperature Greases

In evaluating oils for use in grease at temperatures over 400°F, volatility and stability against oxidation and polymerization are the main considerations. As mineral oils are not suitable for continuous use at such high temperatures, synthetic oils, such as the silicones, esters and fluorocarbons, were examined. The results of preliminary tests are presented in Table 3.

This table shows that the phenymethyl silicone was excellent in regard to both volatility and high temperature stability. The chlorinated silicone was low in volatility but polymerized to a gel at 450°F. The high molecular weight polyester volatilized excessively and polymerized to a solid. The fluorocarbons are known to be exceedingly stable against oxidation but they proved to be excessively volatile at 400°F.

On the basis of the above results, the phenylmethyl silicone fluid was selected for use in subsequent extreme high temperature grease studies. When coupled with suitable thickeners, this fluid provided excellent high temperature bearing performance, which confirms the results reported earlier by the Naval Research Laboratory.* Some of the results obtained at Martinez are presented in Table 4.

This shows that the bearing performance at 450°F was well over the minimum of 500 hours required in Air Force specification MIL-G-25013 (USAF). In addition, the performance at 600° was outstanding. Conventional high temperature greases fail after a few hours at this temperature. Several critical bearing applications exist today in aeronautical applications where reliable grease lubrication must be provided for short periods at approximately 600°F. This requirement can be met using the present phenylmethyl silicones and suitable thickeners. However, improvements must be made in the thermal stability of the oils before bearing performance can be extended to 700°F. Suitable thickeners are available but existing silicone fluids polymerize excessively at this temperature.

TABLE 4

Oil Component: Phenylmethylpolysiloxane, 100-150 CS

	*Bearing Performance**, hr*		
	450°F	*500°F*	*600°F*
No. 3 Grade Grease	1181	621	106
No. 1 Grade Grease			120
No. 0 Grade Grease			140

Limitation on Silicones

Although the phenylmethyl silicones have been shown to be exceedingly stable in high temperature grease applications, a word of caution is in order. It is well known that conventional silicone fluids are limited in regard to lubricity. They are excellent when used under light loads and in rolling motions but tend to show excessive wear when subjected to heavy loads and sliding motions on certain metals such as steel on steel. An example of this wear was experienced in applying silicone fluid greases in bearings of 100 mm and larger bore size. These large roller bearings can be subjected to moderate thrust loads and temperatures approaching 300°F. Figure 3 shows the wear that occurred at the roller ends when using a phenylmethyl silicone grease. No excessive wear occurred when using similar greases containing mineral oils or high molecular weight polyesters. *Continued on page 20*

* V. G Fitzsimmons, R. L. Merker and C. R. Singleterry, Naval Research Laboratory Report 3672, page 1, May 1950.

** CRC L-35 Technique

About the Author

H. A. Woods has been associated with Shell Oil company, Martinez, California, for twenty-three years, progressing to his present position of group leader in charge of grease research. He was born on Russian Hill in San Francisco and attended the University of California, receiving his Ph.G. degree in pharmacy in 1925, and his Ph.C. the year following. As time permitted, Woods joined the salmon fleet in Alaska and toured extensively in Mexico. He is a member of ASLE and several ASTM and CRC committees.

FIG. 3. Rollers showing wear under thrust load with phenylmethyl silicone grease. Temperature approached 300F.

CONCLUSIONS

Mineral oil greases are suitable for continuous use at temperatures ranging from −65°F to 300°F when suitably inhibited. Three short screening tests have been developed for guiding the evaluation of greases for high temperature bearing service. Diester greases are superior to mineral oil greases in applications where both extreme low temperatures and high temperatures are encountered because of their low volatility and excellent temperature/viscosity characteristics.

Phenylmethyl silicones are the only fluids found suitable for use in bearing grease applications at temperatures above 400°F, and these proved excellent at temperatures as high as 600°F. The chlorinated phenylmethyl silicones and the high molecular weight polyesters were found to polymerize excessively at 450°F. The fluorocarbons examined proved to be exceedingly volatile at 400°F. Although the phenylmethyl silicones are satisfactory for use under light loads and rolling motions, care should be taken in subjecting them to heavy loads and sliding motions because of poor lubricity. Some improvement must be made in the thermal stability of existing fluids before they can be used satisfactorily in bearing grease applications at 700°F.

ACKNOWLEDGEMENT

The author wishes to thank Messrs. J. W. Armstrong, L. C. Bollinger and H. M. Trowbridge of the Martinez Research Laboratory for their assistance in assembling the data for this paper and Mr. L. E. Menesini for his excellent photographs.

Discussion of Woods Presentation

By E. S. CARMICHAEL, Socony Mobil Laboratories

My comments to this paper will be brief, because the subject has been clearly presented and most of the questions that would naturally come to the mind of the reader have been fully answered.

It is undoubtedly of interest to the NLGI to note the high degree of correlation that existed in the results of evaluations by the oxygen absorption test, the thin film oxidation test and the short term bearing test. These three types of tests are useful tools for screening lubricating greases with respect to chemical stability.

The importance of carefuly selecting fluids for use in high temperature greases was emphasized by the high temperature grease performance data that were reported for samples of a given type grease which were prepared from various fractions of a Pennsylvania Bright stock. It may be of interest to some if Mr. Woods would indicate the general type of thickener, if he is at liberty to do so, that was used in those particular greases. Also, it is suggested that the same information be given for the phenylmethylpolysiloxane grease, together with comments as to whether the improved high temperature characteristics of that grease were due primarily to the thickener or to the chemical stability of the silicone.

One of the most gratifying features of the paper is that it brings attention again to the progress that the grease industry has made during the past five or six years in the development of improved lubricating greases for high temperature applications. It was only about six years ago that the Military requested the Coordinating Research Council to arrange to have industry to carry out cooperative work to develop a technique for evaluating greases at the 400 to 500°F temperature level. At that time, it was necessary to limit the test method development work to 400°F, because no lubricating grease was then available that could be satisfactorily used at appreciably higher temperatures in the cooperative work. The phenylmethylpolysiloxane grease, which Mr. Woods describes in his paper as giving satisfactory results at 500°F and higher, is indicative of the progress that the lubricating grease industry is making in this field. As was pointed out in the paper, the Air Force has recently issued specification MIL-G-25013 which requires a minimum bearing life of 500 hours at 450°F, and it might also be stated that a CRC panel will shortly consider design features of a tester for evaluating greases at the 700°F temperature level. That is progress.

In conclusion, I would simply like to state that this is an excellent paper and one for which the author is to be commended.

the

NATIONAL LUBRICATING GREASE INSTITUTE

- **Intra-Industry Cooperation**
- **Annual Meeting**
- **Marketing Trends**
- **Technical Society Liaisons**
- **Research Fellowship**
- **NLGI SPOKESMAN**
- **Improve Manufacturing Techniques**
- **NLGI Movie**
- **Disseminate Technical Data**
- **Grease Production Survey**
- **Promoting Tests**
- **Technical Committee Projects**
- **Encourage Research**

an organization devoted to the advancement of the lubricating grease industry

NLGI President J. W. Lane's comments on the record high in Institute membership representation (see page 7) point up that the organization is getting more aid in the development of better lubricating greases for the consumer and better grease lubrication engineering service to the industry. As membership steadily grows and the list of prospects widens, the Institute renders these qualifications for interested firms. Questions will readily be answered by the national office, 4638 Nichols Parkway, Kansas City 12, Mo.

Active Membership: For individuals, partnerships, or corporations manufacturing lubricating grease from basic raw materials. Dues, payable annually are based on annual poundage (excluding gear and extreme pressure type oils) manufactured and invoiced in the preceding calendar year as follows:

100,000 to 2,500,000 pounds	$100.00 per year
2,500,000 to 5,000,000 pounds	200.00 per year
5,000,000 to 10,000,000 pounds	350.00 per year
10,000,000 or over	500.00 per year

Associate Membership: For individuals, partnerships or corporations engaged in a business which is allied with or supplementary to the manufacture of lubricating grease (but not a manufacturer of grease). Dues payable annually at a rate of $200 per year. Each member is entitled to an Associate membership listing in each issue of the NLGI SPOKESMAN and will be listed under one of the following headings:

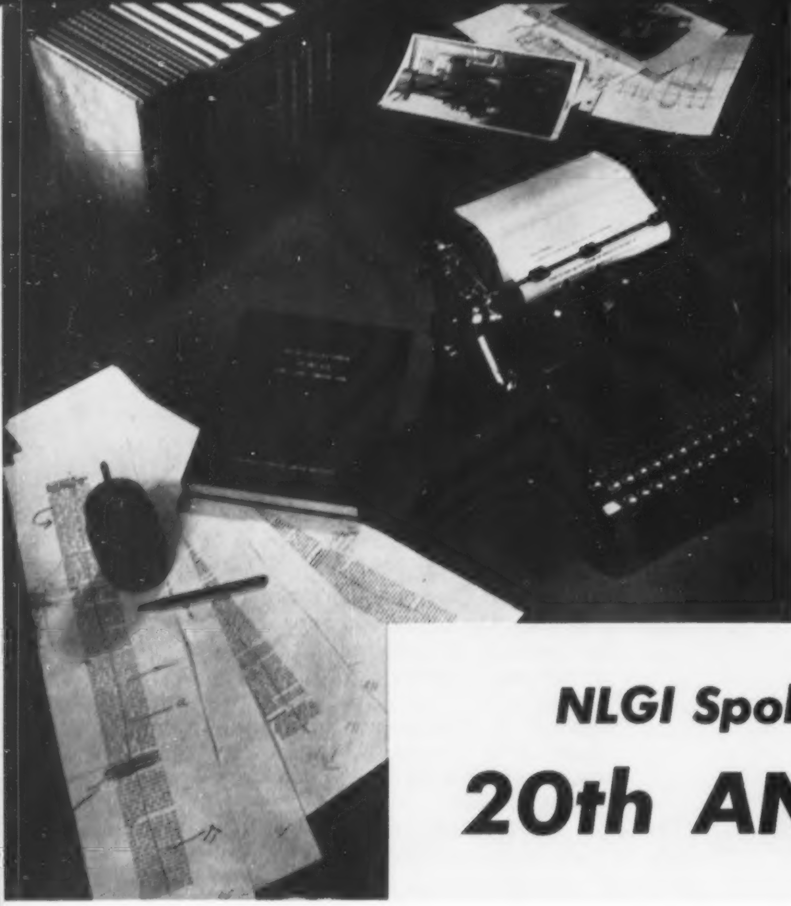
- Container and Closure Manufacturers
- Laboratory Equipment and Supplies
- Manufacturers of Equipment for Application of Lubricating Greases
- Refiners
- Suppliers of Equipment for Manufacturing Lubricating Greases
- Suppliers of Materials for Manufacturing Lubricating Greases.

Marketing Membership: For individuals, partnerships or corporations engaged in the marketing of lubricating grease (but not a manufacturer of grease). Dues, payable annually are based on annual poundage (exclusive of gear and extre[illegible]ssure type oils) marketed and invoiced in th[illegible]g calendar year as follows:

Up to 2,500,000 pounds	$100.00 per year
2,500,000 to 5,000,000 pounds	175.00 per year
Over 5,000,000 pounds	250.00 per year

Technical Membership: For individuals, partnerships, corporations or institutions engaged in technical or scientific research, education, not associated with an individual, partnership or corporation eligible for Active or Associate membership. Dues payable annually, $50 per year. Each member is entitled to a Technical membership listing in each issue of the NLGI SPOKESMAN.

Active members may attend all regular and special meetings of the Institute and may participate in all discussions at these meetings. They are entitled to receive a copy of all general communications, bulletins and technical data issued by the Institute, including minutes of the annual meetings and any special meetings. All other membership classifications have the same rights and privileges of Active membership except voting power, election to office, or to the board of directors, or membership on the standing committees. Associate Marketing and Technical members may appoint a representative to serve on the Technical Committee.



ARTICLE VI—OFFICIAL PUBLICATION

The NLGI SPOKESMAN is the official publication of the National Lubricating Grease Institute. The official title "NLGI SPOKESMAN" shall include the following wording in small letters:

"Journal of National Lubricating Grease Institute."

Revised Constitution and By-Laws

NLGI Spokesman Observes Its 20th ANNIVERSARY

"A NEW NAME, a new policy, a new scope of service . . ." was the announcement made twenty years ago when the first copy of the *Institute Spokesman* was mailed to members. Volume one, number one, was a four-page multilith magazine and that particular March, 1937 issue marked the beginning of a new communication piece for the membership.

That same year—1937, was when the National Association of Grease Manufacturers, Inc., became the National Lubricating Grease Institute and the five-year-old organization had begun to feel the need for the dissemination of information for the industry—thus, the *Spokesman*.

At the conclusion of the first year of publication the magazine graduated from multilith to letterpress, with George W. Miller (now president of Battenfeld Grease and Oil, Buffalo, N. Y.) editing and reporting. The membership began to get the latest technical developments in production, testing and use of lubricating greases.

In the capacity of executive secretary and editor, positions he held for almost ten years, Miller saw the initial printing order grow from 200 copies to more than 1,500. Matching the NLGI's growth through the years, the publication too, had a name change and today's twenty-year-old NLGI SPOKESMAN has prospered and enlarged . . . not only in content, but in reader coverage. More than 95 per cent of the domestic lubricating grease industry is represented on its mailing list, ten per cent of NLGI membership is international in composition and subscribers in 32 nations abroad benefit from Institute information.

Mere physical growth has not been enough . . . the NLGI SPOKESMAN has endeavored to serve the needs of the organization. Informing each member company of the activities and developments in the field, to keep each member company fully informed as to changes in the industry, to disseminate and interpret Institute policies, coordination of NLGI projects, serving the public . . . there are many duties to perform.

How well it has been performing these duties can be measured by analyzing the latest set of magazines—volume twenty, of which this issue is number twelve. Here are some volume twenty high spots:

Membership survey . . . taken last spring got a high return of which over half contained compliments. A great many suggestions have been acted upon, in keeping with the purpose of the survey.

Subscriptions . . . while small when compared with some journals, now reflect all but a minute portion of the industry. To all intents and purposes coverage can be said to be complete.

Paid Advertising . . . reached an all-time high in 1956, reducing the loss factor to a low point. This year has already shown an increase in advertising over 1956.

Awards . . . the latest was given the NLGI SPOKESMAN last fall, when the journal received an award of merit (second place) in competition with 500 other magazines. This is the sixth award made to the NLGI SPOKESMAN in recent years.

In pausing to look backward at the years of accomplishment, the time is also opportune to plan for future years, for the journal is subject to the needs of members in a differing degree . . . it must always be active, to help provide service and data for the Institute.

The officers and board of directors of NLGI have done that pre-planning, allowing for more enterprise and improved communication by the establishment of working committees within the organization, for combined effort and combined success. These member groups include the procurement committee, the technical review committee and the new marketing review committee. Because the NLGI SPOKESMAN has the size to offer publication for interesting papers, more and more material is being submitted to the national offices and the growth in advertising is making a larger magazine possible. What was once a reporting service to keep abreast is now also a reliable reference for an ever-changing business. The past has been good—the future looks even brighter.

G. Miller

Boner

Entwistle

Hart

T. Miller

Swarthout

Under Their Guidance — Spokesman Expands

Besides the contributions of many authors throughout the years, there are many who have assumed the duties and responsibilities of working for the betterment of the publication. In addition to the officers, the Board of Directors and the staff they include Company and Technical representatives of the Institute. Here are some who are associated with the NLGI SPOKESMAN.

George W. Miller, Battenfeld Grease & Oil, Buffalo, N. Y., first editor of the SPOKESMAN. Under his guidance ten years, the journal steadily grew in size and responsibility until it had become a standard reference work for the lubricating grease industry.

C. J. Boner, Battenfeld Grease & Oil, Kansas City . . . chairman of the subcommittee for the procurement of technical papers, charged with obtaining articles of particular interest to Institute members.

George Entwistle, Sinclair Refining, Harvey, Illinois . . . chairman of the editorial review committee (technical) and responsible for the high standards of all technical material presented in the journal.

Frank Hart, Standard Oil (California), San Francisco . . . chairman of the editorial review committee (marketing), in the development of an important new phase of activity presented by the magazine.

Tom Miller, NLGI SPOKESMAN editor, Kansas City . . . formerly supervised publications and public relations for Skelly Oil, has wide newspaper and magazine editorial experience.

Joan Swarthout, NLGI SPOKESMAN assistant editor, associated with the Institute's magazine for two years, has an editorial background from France and New York.

A Four-Point Program To Cut Highway Accidents

By A. E. SPOTTKE

Allstate Insurance Company

THE AUTOMOBILE INSURANCE industry has a big stake in highway safety. It is a 4.5-billion-dollar industry with over 3 billion paid annually by the companies in settlement of losses. When the current expense of doing business is added, the industry today finds itself going heavily into the red. This holds true for virtually every company in the business.

Humanitarian considerations are compelling with all of us. Who would dare say they are not uppermost in our minds when the figures indicate that about 42,000 Americans will be killed in automobile accidents this year and 1½ million more injured. I will not elaborate. All of us travel over our highways—we read the papers—we listen to radio and see TV. The same story is repeated at every point. It changes only in that it becomes more distressing and alarming instead of abating. This deterioration is occurring in spite of the heroic efforts of many to stem the rising tide of destruction.

What can we—an intelligent and free people—do about it? I would like to suggest four measures in which each and every one of us can take a personal part right now in our own state—in our own community—to do something concrete to reach the man behind the wheel.

Let's start by doing something about the plea made by President Eisenhower that we mobilize public opinion and support for action—reasonable and necessary action. We will get just as much traffic safety as we are ready to contribute by our own actions as drivers and pedestrians and as we are ready to work for by supporting a sound program of education, enforcement and engineering in our respective communities and the areas adjoining.

In the several highway safety conferences held during the past two years under the president's leadership, businessmen committed themselves to do something about this problem. They agreed that they could make

Authenticated News Photo.

TRONA† LITHIUM HYDROXIDE

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* BETTER DELIVERIES

GREASE MANUFACTURERS: There are three good reasons why Trona† should be your prime source of supply of lithium hydroxide monohydrate ($LiOH \cdot H_2O$), essential to the production of lithium base greases. (1) **A new and strategically located plant** at San Antonio, Texas (American Lithium Chemicals, Inc.). (2) **Convenient warehouse stocks** of lithium hydroxide, maintained in proximity to the major grease producing areas of the U. S. (see map). (3) **Better, faster deliveries,** because of advantageous rail and motor freight facilities. When planning your current, or future, requirements for LiOH we suggest you contact your American Potash & Chemical Corporation (Trona†) sales representative. His better service costs no more.

TRONA

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an immediate contribution for the better by organizing citizens' groups at the state and local levels to get universal public support of our traffic regulations. Why is this so important and why can it be so significant? Let's face it. Today we have a flagrant disregard of the rules of the road by the great mass of drivers, if not the majority. We are not going to make real headway in tackling this problem until we recognize, as a people, that law observance is as necessary here as it is in all of our other relationships—and practice it—if we are to enjoy our blessings and life itself.

There is a ray of hope in the growing number of citizens' support groups being formed. Where they are properly organized, conscientious and diligent in the job they have undertaken, they are getting results. They are helping to reduce accidents in their states and in their communities, even in the face of a nationwide increase.

Every businessman has a vital stake in this matter. Our whole economy is suffering from the toll of highway accidents and present-day congestion. Congestion is waste. The price of this waste today is colossal and, in addition, accidents are a function of congestion. We know how congestion contributes to accidents on the streets of our cities. Beyond that, congestion many times triggers the accident which occurs far outside the city limits on the rural highway. You know what congestion means to you in cutting into the profits of your business.

From the standpoint of only the economics of our business—let alone humanitarian considerations—businessmen must take an active part in this problem. Working with the authorities through organized citizens' groups, we can change for the better the conditions in our states and communities. I am sure that if we work at it and sell the public on the many benefits and advantages of good traffic conditions, we will bring about wholehearted public support—yes, even public clamor—for strong, intelligent enforcement of our traffic laws and ordinances by the authorities. When 90 per cent or better of our people respect these laws and ordinances, as they do our laws generally, the tragic accident toll and its cost in waste and destruction will surely come down substantially.

Driver Training and Improvement

Let us now consider another area where each and every one of us can do something to better conditions. Only about a third of our high schools have driver training courses today and many of these do not include over-the-road instruction. The fact is that students who have passed these courses have less than half of the accidents of untrained students. Can anyone possibly contend that it does no good to teach our youth while they are in high school, the rules of good sportsmanship, a sense of responsibility and the right attitude when they operate an automobile? We owe it to them, in this day and age, when we are a nation on wheels, to equip them as fully as possible to safeguard themselves and other users of our highways. They are our most precious asset, and I say to you that we are selling them short when we stop with the teaching of the three "R's." That may have been enough in the horse and buggy days, but it isn't anymore today.

We are not going to get driver training courses in the other two-thirds of our high schools in a hurry unless we do some thing about it. But we can do a lot to change things and the opportunities are especially promising right now. If you will go into your communities and take on this assignment as a community activity of your business, I am sure you can make yourself heard at the local level and at the state level, and you will be rendering a public service in which you rightfully can take pride and which will greatly benefit your community and yourselves. A number of states have enacted legislation over the last few years to make it easier for communities to institute these courses. These include the states of Pennsylvania, California, Louisiana, Maine, Florida and Michigan, each of which provides a form of subsidy for high school driver training courses.

Some business organizations—and I am happy to say that my own company is included among these—have made this work a part of their community activity and are making it possible for a growing number of colleges and universities to give courses in driver training to high school instructors. By furnishing a supply of teachers, the high schools in turn have been able to set up the necessary courses to make driver training a required subject for a graduation. If businessmen who are leaders and who not only have vision but possess the know-how, arouse their communities through the parent teachers association, through civic groups such as chambers of commerce, Kiwanis, etc., through an organized citizens group for traffic safety, through the press, radio, TV, etc., through the channels that they use to sell their ideas, they can be a potent force to bring on an early change in the percentage of high schools giving these courses, from 30% to 100%.

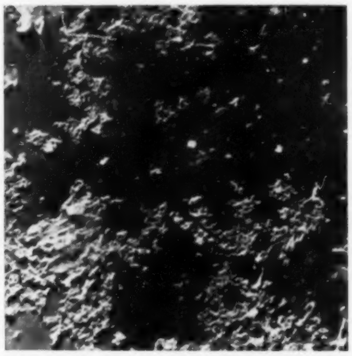
Before leaving this point, let me ask you to consider the effect upon our adult drivers of the well-trained high school student already recognized as an extremely capable operator from the standpoint of the mechanics of operation, if he set the example of courtesy, good sportsmanship and law observance.

As a collateral part of such a program, I would urge that we do something about improving the know-how of our adult drivers. Many of these want to be careful drivers and believe themselves to be good drivers, yet they have driving habits or practices that, under present day conditions, are exceedingly unsafe, border on the dangerous, but they are actually unaware of this.

Without wishing to be presumptuous by telling your industry what it should do, it seems to me that

LITHIUM Base Grease:

1μ



Micrograph showing soap structure of lithium base lubricating grease made from 12-hydroxy stearic acid. Courtesy of Sinclair Research Laboratories, Inc.

ITS MULTI-Properties MAKE IT MULTI-Purpose

IN CHARACTERISTICS

- Non-corrosive
- Water resistant
- High heat resistance
- Rheological properties
- Eliminates abnormal wear
- Soap oxidation stability
- Cold operating properties
- Oxidation and shear stability
- Mechanically and chemically stable

IN APPLICATION

- Prepacking anti-friction bearings
- Lubrication of plain and anti-friction rotating bearings
- Lubrication of vehicle chassis points, wheel bearings, universal joints and water pump
- Lubrication of high-temperature ball bearings
- Aircraft, artillery, instrument and general ordnance maintenance

IN MARKETING

- Lower inventory
- Less dispensing equipment
- No chance for misapplication
- Reduction in lubricating time
- One grease lubricates a vehicle

IN INDUSTRY

- Ordnance
- Manufacturing
- Farm equipment
- Transportation
- Industrial maintenance

TEN YEARS PRODUCTION EXPERIENCE AT YOUR DISPOSAL

Lithium Corporation enjoys an established acceptance among grease makers—and for "multi-reasons" too: production experience, unsurpassed facilities, available inventory and immediate shipment—all combine to assure a reliable source of consistently uniform $LiOH{\cdot}H_2O$. Since we are equally interested in developing better lithium products, why not get in touch with us on your lithium hydroxide problems? A card or letter will bring immediate response.

trends ahead in industrial applications for lithium

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there is a great opportunity to get across to the adult driver, information on good driving practices by a continuing program of telling him what to do and what not to do to keep out of trouble. I can't think of a more opportune time to get these messages across than the time he spends at a service station getting gasoline or service. A concise message, right to the point, on a good driving practice or on something to be avoided will make an impact on the average driver at that time—much more so than when he is comfortably relaxing at home before his radio or TV. I have often thought that a suitably sized poster, properly located at a service station would do the trick, and that a continuing campaign of this kind, possibly with a weekly message, would be considered by a great number of automobile operators as an exceptionally fine, worth-while public service. I will even say this to you—that I know there are those in our industry who would be glad to join with you in such a program.

Enforcement

And now let us look at the question of enforcement.

Those who have been anxiously watching the traffic accident situation are largely convinced that effective enforcement is an absolute "must." I am not for cracking down on individuals to the point where they rightfully feel they are being harassed. However, I do firmly believe that if we modernize our traffic regulations, make them realistic and give motorists adequate and up to date facilities, then we should demand their observance and proper use by all. This is again a place where your as a businessman, especially through organized citizens' groups, because of the power of organization, can play a big part right now. It should not take months or years to get traffic regulations modernized—to make them as uniform as possible—to make them sensible for present day conditions. Well, why don't they do it? What are we waiting for? All you have to do today is to get out on the road and the chances are that every town you pass through has its own set of regulations with its own peculiarities. And we know that this holds for most of the states too. This makes absolutely no sense. What is especially disturbing is that these differences make it impossible even for the conscientious motorist to know what he must or must not do, and this very definitely contributes toward a loose regard or even a disregard of our traffic regulations by the great mass of motorists. I think that we as businessmen can do a lot to change this. We do not have to be traffic experts. Let's leave the actual doing to those who have this responsibility as their public trust, but let us demand that action be taken and let us give them our wholehearted support when they take the necessary action. And let's get the people in our community lined up in support by the use of press, radio and TV.

Let me, at the risk of repetition, say again that we need observation and enforcement. There is nothing which will so better driving conditions on any highway and add so much to the safety of the motorist as an alert traffic officer whose presence is conspicuous and recognized by all.

The Road Program

Finally, while Congress has acted on our road program, the job now is to expedite it, to get our plant where it ought to be for 1956, and especially for 1965 when we will have at least another 20 million cars on our highways. We should help in every way possible to inform our citizens and our communities of the needs and benefits of the highway program—of the needs of all sound proposals for construction of additional facilities. There will be resistance at many points to some of the details of the program. Everybody wants modern highways, but it seems that no one wants them running through his backyard. If we do not prepare now to pave the way for good public acceptance, we may find intolerable delay in the completion of this job which at best is ten years late.

Finally, as good citizens, we should give encouragement to those who are capable, who are trying to do an honest job, so that the vast sum appropriated for this work will actually be applied to the task. This is the kind of activity with which we should charge ourselves, to contribute our bit to make successful in the shortest possible time the effort to give our nation a road and highway plant that will take us out of the horse and buggy age and enable the motorist to use his automobile to give him that service and enjoyment which he rightfully ought to expect and which we hope he will fully realize, toward the end of a greater national well being. ■

About the Author

A. E. Spottke has been vice president of Allstate Insurance company since 1952. He began his career in 1926 with the National Bureau of Casualty Underwriters, where he was manager of the automotive division from 1932 to 1946. In 1946 he was named secretary. Spottke accepted the position of vice president and manager of the New York office of the Massachusetts Bonding and Insurance Company in 1948. Two years later he joined Continental Casualty Company as vice president and director.

Patents and Developments

Lubricating Grease of Synthetic Oil And a Complex Thickener

The following is an example of a grease prepared in accordance with U. S. Patent 2,750,341 issued to Esso Research-Engineering:

A complex ester oil of moderately high lubricating viscosity at ordinary temperatures, was prepared by coesterifying sebacic acid and glycol, using a monohydric alcohol to complete the esterification. One mol of glycol and two mols of dibasic acid were used, along with two mols of monohydric alcohol such as the commercial alcohol mixture derived from coconut oil and sold under the trade name "Lorol B."[1] This ester was thickened to a grease consistency by using 15% of a one-to-one mol ratio lithium acetate lithium soap complex. The soap was a "Hydrofolate," being derived from "Hydrofol Acids 54," or commercial substantially saturated hydrogenated fish oil acids which have the general average chain length and chemical properties of stearic acid. The dry soap-salt compound or complex and the complex ester were mixed together and heated with continuous stirring to a temperature of about 500°F., or until all soap-salt complex had melted. The molten grease was then cooled without stirring. It had a smooth buttery appearance, with an unworked penetration value of 200 mm./10 in the ASTM penetrometer. When worked 60 strokes in the Standard ASTM grease worker, it showed a penetration value of 220 mm./10. It was still stable after working 100,000 strokes in the grease worker. Its dropping point was 408°F. and it showed no water solubility.

Instead of using the complex ester described above as the only oil ingredient, a part of such ester may be replaced by an ordinary simple diester of dibasic acid such as di-2-ethyl-hexyl sebacate or adipate. In any case, however, the latter simple ester should not exceed in quantity the amount of complex ester in the oil blend. It is desirable also to add an oxidation inhibitor, for example 1% by weight, based on the total composition, of phenothiazine. A grease prepared as just described was found to have a dropping point of 440°F., a worked penetration of 200 mm./10 after 60 strokes, complete stability after 100,000 strokes, and just a bare trace of water solubility.

[1]"Lorol B":	Per cent
C_{10} alcohol	3
C_{12} alcohol	46
C_{14} alcohol	24
C_{16} alcohol	10
C_{18} alcohol	17

FOR THE MANUFACTURE OF GREASES THAT DELIVER

Top Performance...

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GULF QUALITY STOCK OILS

A COMPLETE line of stock oils, quickly available to you through strategically located warehouses, terminal facilities, and refineries in 31 states from Maine to New Mexico. Also quality petrolatums.

GULF

GULF OIL CORPORATION
GULF REFINING COMPANY
2927 GULF BUILDING
PITTSBURGH 30, PA.

Average number of carbon atoms—13.5. See U. S. Patent No. 2,560,588.

Rapid Gelling Aluminum Soap

A rapid gelling basic aluminum isooctanoate soap particularly suitable for flamethrower use, rather than for greases, is described in U.S. patent 2,751,283, issued to Standard Oil Company (Indiana). The method involves reducing the moisture content of the soap to below about 1.5 weight per cent, heat treating the soap while contained in a sealed vessel for about 2 hours at about 285°F., and preventing the transfer of gasiform fluids from the soap during the heat treating step.

U. S. Patent 2,751,284 describes a method using methyl ethyl ketone or acetone for the dehydration operation.

Alkaline Earth Metal Base Greases

Greases, being physically gel systems of fluid lubricant and gelling agents, are normally prepared by pressure saponification of fat stock, followed by dehydration of the metal soap, cutback with mineral oil, hydration, and reduction to the consistency grade desired. The principal characteristics of greases which bear importance as far as manufacture and use are concerned, comprise consistency, consistency stability, melting or flow point, yield value, the free acid or alkali content, and stability in storage and use. Numerous techniques have been developed for both batch and continuous methods of grease preparation. However, these techniques provide for little flexibility in the grease composition for a given type of grease and are build around expensive low viscosity index lubricating oil fractions. Also, prior methods are applicable to those types of grease wherein the attainment of a stable gel structure presents little difficulty as, for example, aluminum or lithium soap greases. It is generally considered that it is more difficult to attain good texture, high yield values, and stability in the manufacture of soda soap, soda-lime soap, and lime-base greases than other types of grease. Those processes directed to the preparation of lime-base greases require tedious processing techniques, employing expensive lubricating oil stocks, and often depend upon expensive additives, as high molecular weight synthetic polymers, to attain the desired results. Automotive chassis greases have been prepared using Gulf Coast type lubricating oils which are entirely satisfactory performance-wise, but the cost of manufacture is high and the processing technique often tedious. In addition, no flexibility of the composition is attained whereby chassis greases can be prepared for use in divergent climatic conditions requiring stringent viscosity/temperature relationships in the grease using prior methods of manufacture.

Another difficulty with existing grease manufacture processes and compositions is that they are not amenable to the use of solvent-refined lubricating oils unless low viscosity neutral fractions are used, and even then the required soft, fine grain texture and compatibility with metal soaps is lacking. Solvent refined oils have not generally been used in the manufacture of greases, especially lime-base greases because of the incompatibility of the oil with the lime soaps and the fact that the viscosity of the solvent refined oils cannot be varied within the broad limits necessary to form greases operable under extremes of climatic conditions. If it is attempted to raise the viscosity index of the solvent refined oils by employing blends of solvent refined neutral stocks and high viscosity index solvent refined bright stocks, the result is a destruction of the gel structure of the grease.

In its U. S. Patent 2,755,248, the Pure Oil company states that grease compositions may be prepared using solvent refined lubricating oil stocks by including in the formulation substantial portions of solvent extract from the solvent refining of lubricating oils. Greases formulated in accordance with this patent, using the techniques described and the compositions disclosed, not only eliminate the foregoing difficulties but also meet the most exacting specifications. Greases formulated in accordance with this patent do not need expensive additives or expensive highly refined lubricating oil bases as a part of the composition in order to meet the required viscosity/temperature relationships for various climatic conditions, the tackiness and water-insolubility required of a chassis lubricant, or the flexibility required for economic production. The diagram is a simplified representation of the apparatus employed and the flow of ingredients in conducting the process.

The patent contemplates a grease which has a small moisture content for use at temperatures up to 150°F., under medium pressures and medium speeds and which contains a substantial amount of a solvent extract from a mineral lubricating oil and a small amount of lime-soda soaps. The solvent extracts used are obtained during the manufacture of neutral and bright lubricating oil stocks.

In a typical operation, desalted crude oil is first charged to a distillation unit where straight run gasoline, two grades of naphtha, kerosene, and virgin distillate are taken off, leaving a reduced crude residue. The reduced crude is continuously charged to a vacuum distillation unit where three lubricating oil distillates are taken off as side streams, a light distillate is taken off as overhead, and a residuum is withdrawn from the bottom of the tower. This residuum is charged to a propane deasphalting unit wherein propane dissolves the desirable lubricating oil constituents and leaves the asphaltic materials. A typical vacuum residuum charge to the propane deasphalting unit may have an API gravity of 12.9°, viscosity SUS at 210°F. of 1249; flash 585°F., fire 650°F., C.R. of 13.9 weight per cent and is black in color. The deasphalted oil may have an API gravity of 21.5° to 21.8°, visco-

sity SUS at 210°F. of 165-175, NPA color 6-7, flash 575°F., fire 640°F., and C.R. of 1.7-2.0. The deasphalted oil and various lubricating oil distillates from the reduced crude are separately subjected to solvent extraction for the separation of non-aromatic from aromatic constituents. The refined oil or "raffinate" from such processes is used as blending stocks and the solvent extract, containing the undesirable aromatic constituents, is the material found useful.

For example a Van Zandt crude oil with an API gravity of 33.1 was topped to remove such light fractions as gasoline, naphtha, kerosene, and a light lubricating distillate. The vacuum residue was a reduced crude having a viscosity of 1251 SUS at 210°F., 2.2 per cent sulfur, and an API gravity of 12.6. After propane deasphalting, the oil had a viscosity of 174 SUS at 210°F. and an API gravity of 21.7. This deasphalted oil was treated with phenol to produce a raffinate from which an aviation lubricating oil may be produced. The extract phase from this phenol treatment is ready for use in preparing greases in accordance with this patent.

By using solvent extracts in substantial quantity in grease compositions, the processing technique is simplified and the resulting products display the desired viscosity/temperature relationships, pass the commercial requirements of consistency stability, display the required characteristics of pumpability, tackiness, and require less metal soap in the composition to give a good grease consistency. Furthermore, greases prepared are adhesive to metal parts, water-insoluble, and provide excellent lubrication at temperatures up to 150°F. or as low as −30°F.

The following formula sets forth the general limits of the ingredients of the new grease. Grease compositions prepared in accordance with this patent may be of any consistency from 0 (worked penetration 355-385) to 5 (worked penetration 130-160).

	Percent by weight
Fatty acids	8-9
Hydrated lime	1.5-1.7
Caustic	.01-0.20
Solvent extract	60-65
Mineral oil	24-30
Water	0.2-.35

A specific example of a grease composition compounded in accordance with this invention comprises:

Animal fatty acids	8.40
Hydrated lime	1.60
Sodium hydroxide	0.06
Phenol extract from bright stock mfr	62.77
Neutral lubricating oil	26.89
Water	0.28

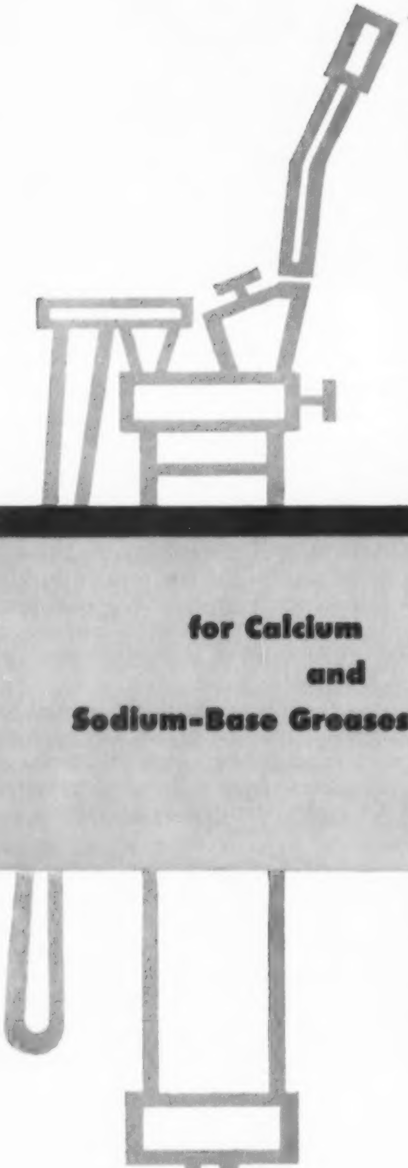
Continued on page 34

to give your Greases top performance
. . . use top-performing

Because many characteristics of good greases depend upon their fatty components, Emery Fatty Acids are manufactured to give you the top performance you seek . . . yet at a low processing cost.

Compare and you will see that all Emery Fatty Acids are more stable to oxidation . . . possess a high resistance to rancidity and yellowing . . . contain a low ash and unsaponifiable content. And their uniformity from batch to batch keeps processing costs low by minimizing formula changes and consistency adjustments.

Since each characteristic has an important influence on your final quality, you buy with assurance when you specify an Emery Fatty Acid.



for Calcium and Sodium-Base Greases . . . . .

In addition to higher quality and better yields, Emery Animal Fatty Acids offer these other advantages over natural tallow and fats . . .

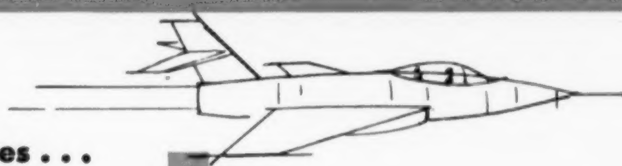
1) **consistent composition for uniform performance,**
2) **high-stability,**
3) **lighter, more uniform color,**
4) **high reactive content for greater yield, and**
5) **faster saponification for quicker kettle turnover.**

for Lithium Base Greases . . .

Hyfacs® Hydrogenated Castor Oil and 12-Hydroxystearic Acid are excellent performance-wise and dollar-wise for multipurpose greases. Their uniformity minimizes consistency adjustments, and their high quality and low moisture content provides maximum hydroxyl content.

Other Hyfac Tallow and Fish Fatty Acids and Glycerides furnish a range of compositions for latitude in compounding all types of multi-purpose greases.

Emery *fatty acids*



for Aluminum Base Greases . . .

Aluminum stearates made from Emersol® Stearic Acids are exceptionally high in quality. In processing, their excellent color stability permits the economies of bulk handling and their uniformity enables consistent manufacturing procedures.

Grease compounders too like these stearates, since they possess 1) uniform color, 2) superior resistance to oxidation, rancidity and yellowing, and 3) consistent composition for uniform performance. Finished greases are of top quality and possess excellent stability.

Other Emery solid acids with different ratios of palmitic, stearic, and higher molecular weight acids are available also for special grease formulations, to add special properties.

for Synthetic Lubricants and Greases . . .

Emolein® Lubricant Esters as base fluids for synthetic lubricants and greases offer outstanding viscosity-temperature characteristics, excellent oxidation and thermal stability, low sludging and coking tendencies and excellent lubricity. They meet a wide range of military and civilian requirements, as outlined in Technical Bulletin No. 409, available from the Organic Chemical Sales Dept.

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for All Greases . . .

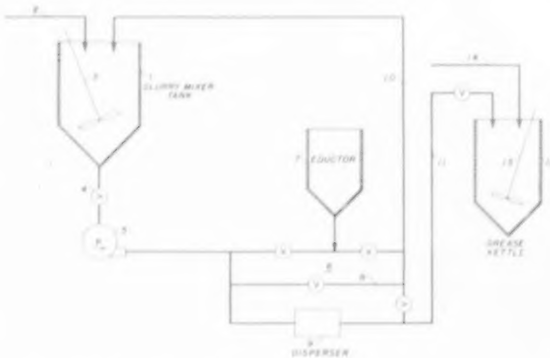
Emery's complete line of fatty acids offers maximum selection to achieve almost any combination of characteristics for compounding special greases for specific applications, or for any greases involving fatty constituents.

For specific information and selection assistance on fatty acids and derivatives for greases, answers to problems involving fatty materials, or samples of any Emery Product, write Emery Industries, Inc., Dept. E-3, Carew Tower, Cincinnati 2, Ohio

The grease of the above formula shows the following characteristics and tests:

Soda soap .... percent	0.8
Lime soap .... do	9.0
Mineral oil .... do	89.0
Free acid .... do	.00
Free alkali .... do	.03
Unworked consistency (A.S.T.M.)	294
Worked consistency (A.S.T.M.)	290
Apparent viscosity in poises at 77°F. with rates of shear (sec. $-^1$):	
10	720
100	162
1,000	53
10,000	28
Consistency stability	Good

In the accompanying diagram lubricating oil stock is introduced to lime-slurry mixer 1 by means of line 2. Mixer 1 is fitted with stirrer 3 and valve 4 controlling the flow of slurry to pump 5. Pump 5 is connected to dispersion and recirculating system 6, comprising eductor 7, by-pass 8, disperser 9, and recycle line 10. Line 11 serves as a take-off for completed slurry conveying it to reaction kettle 12, fitted with stirrer 13 and caustic inlet 14.



Halogenated Hydrocarbon-Treated Greases

Conventional lubricating greases consists primarily of lubricating oil thickened to a more or less firm and solid consistency with a soap which has limited solubility in the oil. In general, hardness or "consistency" increases with soap content. Electron photomicrographs of some of such greases show that the soap is commonly of reticulate or fibrous construction, holding the oil in a solid "structure." Various means have been devised to modify the soap structure, e. g. by mixing different kinds of soaps, by homogenization or severe mechanical working, by forming a complex of the soap with a salt of lower molecular weight, etc. Greases of various properties have been so produced, some of them giving satisfactory performance at unusually high temperatures and having physical or structural stability, etc. It should be emphasized that these prior treatments and modifications have dealt largely with the soap structure and have not particularly affected the oil. In these ways the consistency of the grease under various conditions has been affected.

In U. S. Patent 2,755,249 issued to Esso Research and Engineering Company, there is described a process which is considered to be a departure from previous efforts to improve grease structure in that it tends to change the character of the oil itself. It should be noted that grease lubrication has long proceeded upon the general theory that the oil in the grease accomplishes most of the actual lubrication and hence should be of such viscosity, viscosity index, etc., as would be used for liquid lubrication of the same parts if liquid lubrication were feasible. (Greases usually are employed only where leakage, dirt, and related considerations make the use of a liquid lubricant impractical.) Hence the prior art has assumed that the oil in a grease should be unmodified; therefore, any improvements in consistency, structure, should be obtained by modification of the soap.

According to the patent, a conventionally prepared lubricating grease, for example a soda base grease composed primarily of mineral base lubricating oil containing about 5 to 30 or 40% by weight of soda soap of higher fatty acids (in the C_{12} to C_{24} range, usually around C_{16} to C_{22} or so), is modified by heating it with a highly halogenated lower paraffin. Carbon tetrachloride is the preferred treating agent though tetrabromide may be used. Hexachlorethane or hexabromethane may also be used, or monochlor-tribromo-, di-chlor-dibromo-, or trichlor-monobromo-methane.

While the exact mechanism of the reaction is not fully understood it is believed the reaction results in a loose condensation of the molecules of the oil in the grease, greatly increasing its consistency for a given soap content. The effect superficially is much like the effect of using a very viscous oil instead of the normally used lubricating oil. In use, however, the hardened grease resulting from the treatment with the haloparaffin, has the usual lubricating properties of the lighter oil. The net effect is to achieve the production of a relatively very firm and hard grease, e.g., a block grease containing only those proportions of soap normally used for the softer greases. Since the treat-

ment of the present invention is accompanied by evolution of the dry hydrohalide, it is believed that a reaction proceeds about as indicated:

$$4C_nH_{2n+2} + CX_4 \text{ (or } C_2X_6) \longrightarrow C_nH_{2n+1}-\underset{C_nH_{2n+1}}{\overset{C_nH_{2n+1}}{\overset{|}{\underset{|}{C}}}}-C_nH_{2n+1}$$

where X is a halogen, preferably chlorine.

Hence the oil is very appreciably thickened but the grease structure, or the physical structure of its normally liquid component, is not so stable but what it can break down to some extent, on contact with the metal surfaces to be lubricated (which are commonly at elevated temperature) to give the lubricating properties of the usual lighter oils.

Example I

A soda base grease containing about 28% by weight of the soda soap of rapeseed oil and about 72% of mineral base lubricating oil of about 500 S.S.U. viscosity at 210°F. was tested in the Standard A.S.T.M. grease penetrometer and found to have a penetration value of 200 mm./10. This is a grease of about medium hardness.

100 grams of the grease just described was heated to 310°C. and stirred with three grams of carbon tetrachloride for one hour. The reaction was carried out in a three necked flask fitted with a reflux condenser, water cooled. At about 300°C. the carbon tetrachloride, considered very inert at ordinary temperatures, began to react with the grease. The reaction liberated hydrogen chloride as a dry gas. At the end of the reaction the grease was found to be free of carbon tetrachloride. It had no measurable residual acidity.

The reaction may be conducted at normal pressure, using a reflux system, at temperatures of about 300 to 350°C. If pressure is used the reaction may be carried out at 200° to 350°C. The time of reaction may vary from 10 minutes to 10 hours, 15 minutes to an hour being preferred. Reaction should be reasonably complete.

Example II

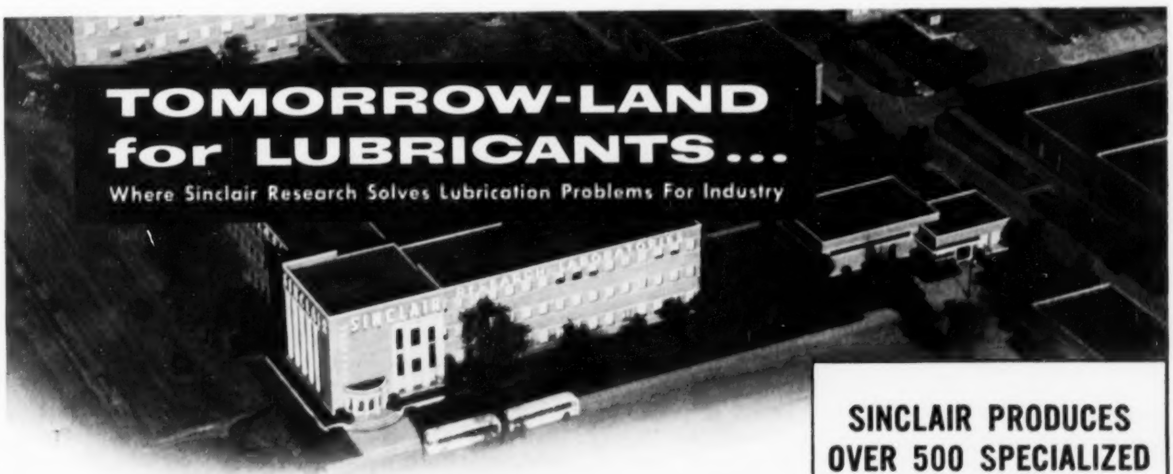
100 g. conventional grease as in Example I
3 g. -chloromethyl ethyl ether

The mixture was heated to a temperature of 300 to 310°C. for 15 minutes in a steel bomb under pressure. The final product was brown in color and hard. Physical properties of the final grease:

Penetration:

Unworked	28 mm./10.
Worked	75 mm./10.
Dropping point	500°F.

Product very water soluble.



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Wide Temperature Range Alkali Metal Greases Containing Excess Alkali Metal Hydroxide

U.S. Patent 2,755,256, issued to the Texas company, relates to ball and roller bearing greases which are characterized by high dropping points and outstanding performance over a wide temperature range. The novel alkali metal greases are suitable for operation at temperatures as low as −20°F. and as high as 500°F. and upwards, and they result from elevated temperature digestion of a mixture comprising mineral oil alkali metal soaps of a fatty material of prescribed composition, and a critical amount of excess alkali metal hydroxide. The critical factors in the production of the greases are the critical quantity of excess alkali metal hydroxide present during the high temperature digestion, the composition of the fatty material from which the alkali metal soaps are formed, the temperature and duration of the digestion.

The greases of this patent are prepared by digesting at a temperature of 480 to 550°F. for a period of 2 to 5 hours a dehydrated reaction mixture comprising 15 to 25 per cent alkali metal soaps of a fatty material having an iodine number of at least 90, 60 to 80 per cent mineral oil and 1.3 to 2.3 per cent alkali metal hydroxide. After digestion at the prescribed temperature, the grease is stirred down to a temperature of about 200°F. at which temperature it is drawn. Additives comprising 1 to 10 per cent of the total grease composition may be added during the cooling of the grease after the elevated temperature digestion.

The alkali metal greases produced are characterized by dropping points over 500°F. and possess good low temperature torque properties so that they are properly classified as wide temperature range ball and roller bearing greases. The low temperature properties of the grease produced can be improved by milling. An improvement of 10°F. in the low temperature properties results from milling the drawn grease.

Accordingly, it is recommended that the greases of this patent be milled if they are to be utilized in lubrication where low temperatures are encountered.

These alkali metal greases are claimed to be important additions to the field of commercial greases. The high dropping points and good low temperature torque properties adapt them for use over a wide temperature range. The sodium base greases are particularly useful commercial greases, being buttery-type greases with dropping points over 500°F.

Soap-forming materials possessing a substantial olefin content are required for the formation of the alkali metal greases. The soap-forming stock, which can be soap-forming fatty acids, fatty esters of mixtures thereof, should possess an iodine number of at least 90 and preferably between 90 and 130.

A particularly preferred soap-forming material comprises a mixture of menhaden oil and hydrogenated fish oil fatty acids, which latter are commercially known as Snodotte acids. A 3 to 1 menhaden oil-Snodotte acid mixture having an iodine value of approximately 110 has proven particularly useful as a soap-forming stock.

The soap-forming material of this patent is employed in such amounts that the alkali metal soap content of the final grease composition comprises approximately 15 to 25 per cent of the total grease composition. Ordinarily the soap content of the grease is within the range of 18 to 22 per cent.

The concentration of excess alkali metal hydroxide present during the elevated temperature digestion is critical and lies in a very small range. It is necessary to maintain concentration of excess alkali between the ranges of 1.3 and 2.3 per cent of the final calculated composition of the grease in order to produce a high dropping point grease. If the excess alkali metal hydroxide concentration is below or above the prescribed range, there is a significant lowering of the dropping point of the product grease.

It has been discovered that the viscosity of the paraffinic mineral oil determines what is the optimum amount of excess alkali metal hydroxide to be used. When more viscous paraffinic mineral oils, for example, SAE grade 30 or 40, are employed in formulating the grease, best results from the viewpoint of dropping point are obtained if the excess alkali metal hydroxide concentration is in the range of 1.4 to 1.6 weight per cent whereas with less viscous paraffinic mineral oils, such as SAE grade 10 to 20 oils, optimum results from the viewpoint of product quality are obtained if the excess alkali metal hydroxide concentration is in the range of 1.7 to 2.1 weight per cent. However, regardless of the viscosity of the paraffinic mineral oil employed, the total amount of excess alkali metal hydroxide falls within the prescribed range of 1.3 to 2.3 weight per cent of the final calculated grease composition.

The excess alkali metal hydroxide may be added either in its entirety prior to elevated temperature digestion of the grease mixture or in two separate fractions with the major fraction being introduced prior to digestion and a minor fraction being added during the stirred cooling of the grease. The entire excess alkali metal hydroxide or the major fraction thereof is added to the grease mixture together with the stoichiometric quantity required to saponify the soap-forming material. The split feed incorporation of the excess alkali metal hydroxide is the preferred procedure and produces a grease having superior high temperature properties. In the split feed addition of excess alkali, approximately 60 to 80 per cent of the total excess alkali metal hydroxide is added together with stoichiometric quantity of alkali required for neutralization of the soap-forming material; the remaining 20 to 40

per cent of total excess alkali is added during the stirred cooling of the grease at a temperature of about 300°F. A saturated aqueous solution of alkali metal hydroxide serves as the means of introducing the excess alkali and the stoichiometric alkali required for saponification of the soap-forming material.

The greases may be prepared from all alkali metal hydroxides and the resulting greases are characterized by wide temperature range properties. Sodium and lithium base greases possess exceptionally high dropping points and good low temperature torque properties.

The temperature and duration of the digestion of the mineral oil, alkali metal soaps and excess caustic are also decisive in determining the quality of the grease. The digestion must be effected at temperatures between 480 and 550°F. to produce greases characterized by dropping points over 500°F. and good low temperature torque properties. A temperature between 500 and 550°F. is particularly preferred for the digestion. A digestion period of 2½ to 5 hours is prescribed but digestion times of 3 to 4 hours have proven particularly advantageous.

After the elevated temperature digestion, the grease is cooled with stirring to a temperature of about 200°F. at which temperature it is drawn. It is important to stir the grease during the cooling period to prevent it from becoming stiff during a phase change which occurs at about 350°F. It has been discovered that cooling the grease kettle at a rate of 50 to 60°F. per hour while the grease is stirred down to 200°F. results in superior products. Advantageously, the grease is screened through 60 mesh screens during the drawing operation.

Milling of the drawn greases produces a harder product. For example, a NLGI No. 2 grade grease can be converted to a No. 3 or No. 4 grade grease by milling. In addition, milling effects approximately a 10°F. improvement in low temperature torque properties of the grease composition.

Various additives are blended into the grease after the elevated temperature digestion of the saponified, dehydrated mixture. For example, diphenylamine, an oxidation inhibitor, may be blended into the grease at a temperature of about 220 to 250°F. during the stirred cooling of the grease. Aluminum stearate, which im-


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parts water resistance, is added at about 500°F. or at the end of elevated temperature digestion. Ordinarily the final grease composition contains 0.5 to 3 weight per cent diphenylamine and 3 to 7 weight per cent aluminum stearate.

Poly (Siloxyglycol) Grease Compositions

In recent years, careful studies have been made of numerous synthetic oils to replace in whole or in part the petroleum base oils in the preparation of grease compositions. It has been realized that petroleum base oils have numerous deficiencies, such as viscosity indices lower than desired for present operating conditions in high speed bearings. Thus, petroleum oils which are suitable at low temperatures are too volatile at high temperatures, and vice versa, petroleum oil having high viscosities at high temperatures become too stiff and too resistant to flow at low temperatures. Other disadvantages of petroleum base oils include high pour points, high volatility, etc.

Numerous synthetic oils have been prepared to satisfy certain requirements in the lubrication field. For example, polyether synthetic base oils normally are useful at temperatures lower and higher than can be had with mineral base oils. However, polyether oils inherently are readily susceptible to oxidation at high temperatures (e.g. 400°F.) and they become too viscous at such low temperatures as −100°F.

Other synthetic oils (e.g., poly (siloxane) base oils) have been prepared to rectify the disadvantages of such oils as exemplified hereinabove. Although the synthetic base oils such as poly (siloxane) base oils have high viscosity indices, low pour points, low volatility, high heat stability, etc., they are too expensive for general use in the lubrication field. The high cost of such base oils having these desirable properties has been a barrier for their use in the preparation of greases adaptable for general service lubrication

Present day greases must be able to lubricate effectively under conditions of high temperature, that is, temperatures considerably in excess of 400°F., and, in certain instances, in the range of 500°F., and under conditions of low temperature, such as −100°F. In the high temperature range greases, numerous military and industrial grease specifications describe greases having dropping points of about 400°F. as a minimum. This need for high temperature greases, for example, is the result of increased speeds of gears, bearings, and other moving parts.

The continuing trend to manufacture automobiles with lower centers of gravity has made it necessary to use smaller gears, particularly in such gear assemblies as the differentials and transmissions. The smaller gears thus used move at greater speeds and have considerably greater pressures exerted upon them per unit area than the older type gear assemblies. Thus, machines having higher loads on bearings and gears along with greater speeds, require grease compositions which will function at higher temperatures than heretofore.

According to U.S. Patent 2,756,212 issued to California Research Corporation, it has been discovered that highly useful grease compositions which are plastic at low temperatures, have excellent heat stability, have low volatility, etc., can be obtained at lower cost than heretofore possible. Such grease compositions are prepared by incorporating a grease thickening agent in a poly (siloxyglycol) base oil, which is a polymeric product obtained from a dihydric alcohol and a dialkyl dihalosilane. These grease compositions comprise a major proportion of a poly (siloxyglycol) base oil, and a sufficient amount of a grease thickening agent to thicken the oil to the consistency of a grease. They may contain minor amounts of other base oils (e.g., synthetic ester type oils) blendable with the poly (siloxyglycol) oils.

The poly (siloxyglycol) base oils produced by the reaction of dihydric alcohols with dialkyl dihalosilanes are linear polymers of the formula:

$$\mathrm{HO}(-\underset{\underset{\mathrm{R_2}}{|}}{\overset{\overset{\mathrm{R_1}}{|}}{\mathrm{Si}}}-\mathrm{O}-\mathrm{R}-\mathrm{O})_n\mathrm{H}$$

wherein R_1 and R_2 represent monovalent organic radicals, R represents a divalent organic radical, and n represents the number of units in the polymeric compound.

R_1 and R_2, the monovalent organic radicals, each contain a total of from 1 to 6 aliphatic carbon atoms. Thus, R_1 and R_2 can be aliphatic radicals or alkyl-substituted aromatic radicals. Although R_1 and R_2 may be similar or dissimilar, it is preferred that at least one of these monovalent radicals is an aliphatic radical. Thus, R_1 and R_2 can both be similar or dissimilar aliphatic radicals. However, when one of these monovalent radicals is an aliphatic-substituted phenyl group, the other monovalent organic radical is preferably an aliphatic radical. Examples of R_1 and R_2 monovalent organic radicals include radicals derived from ethane, methane, propane, isopropane, butane, isobutane, tert-butane, pentane, isopentane, neopentane, hexane, isohexane, benzene, toluene, etc.

The R of the above formula is a divalent organic radical containing a total of from 2 to 12 carbon atoms; a total of 2 to 8 carbon atoms being preferred. The R divalent organic radical includes straight-chained and branch-chained radicals. It is especially preferred that R be a branch-chained divalent organic radical containing from 3 to 8 carbon atoms. Examples of R radicals include the divalent radicals obtained by removing the hydroxy groups from the following dihydric alcohols: ethylene glycol; propylene glycol; 2, 3-butanediol; 2, 3-pentanediol; 2, 4-pentane-

diol; 2-methyl-1, 3-butanediol; 2-methyl-2, 4-butanediol; 2-methyl-3, 4-butanediol; 1, 8-octanediol; 1, 10-decanediol; 1, 12-dodecanediol, etc.

As noted above, the n of the above formula represents the number of monomeric units which are present in the polymer. The number representing monomeric units is of such value that the molecular weight of the polymeric compound is from 240 to 5000; with the preferred molecular weight ranging from 350 to 3500.

Thickening agents which can be used to thicken the base oils set forth above include the following:

Metal soaps of fatty acids, such as the monovalent and polyvalent metal soaps of fatty acids containing from 8 to 30 carbon atoms, e.g., sodium stearate, sodium oleate, calcium oleate, aluminum oleate, barium stearate, strontium stearate, etc.;

Complex basic aluminum soaps, e.g., aluminum benzoate stearate, as described in U.S. Patent 2,599,553.

Phenylene diamides, e.g., N, N′-acetyl steroyl-p-phenylene diamine, as described in Patent No. 2,698,-300;

Acyl ureas, e.g., octadecanoyl urea, as described in Patent No. 2,709,157;

Polyamides, that is polyamides produced from amines and dibasic acid (e.g., from hexamethylene diamine and sebacic acid).

A metal salt of a polyamic acid.

Silica, and other thickening agents.

The thickening agents may be used in the polymeric base oil described hereinabove in amounts of from about 15% to about 25%. If it is desired to thicken oils to such consistency that they may be used as filter oils, the amount of thickening agents may be reduced to as low as 5% by weight.

The new base oils are prepared by reacting a dialkyl dihalosilane (e.g., dimethyldichlorosilane) with a glycol (e.g., ethylene glycol) alone or in the presence of a base (e.g., pyridine).

Example

130 grams of dimethyl dichlorosilane was slowly added to a mixture of 76 grams of propylene glycol in 158 grams of pyridine at temperatures ranging from 50-60°C. After the reaction mixture had been washed with water and dried, it was rectified to 300°F. at absolute pressure of 10 mm. of mercury. The reaction product (poly (dimethyl siloxypropylene glycol)) remaining contained 34.2% silicon.

4.3 grams of the reaction product obtained above was thickened to the consistency of the grease with 0.5 gram of silica. The product was a smooth, translucent grease which showed a wear of only 0.058 mm. in a 4-ball wear test machine over a period of 0.5 hour at a temperature of 200°F. and a pressure of 22 p.s.i.

The stability of the base oils herein in grease compositions was determined according to a thin film test procedure. This test measures the stability of grease compositions, particularly the retention of pliability and the resistance to deterioration under exposure of a thin film to high temperatures. The test also indicates other grease characteristics such as tendency to bleed, flake (some greases although soft and greasy, crack and flake) and tendency to become tacky. This test is performed as follows:

The grease to be tested is coated on a metal strip. The grease coating is of uniform dimension: 1/32 in. thick, $7/8$ in. wide and 2½ in. long. This grease sample is then placed in an oven at 300°F. and observed at periodic intervals until the sample loses its grease-like characteristics.

When 0.1 gram of an organo selenide and 0.1 gram of N, N′di-a-naphthyl-p-phenylenediamine had been added to the grease above, the grease composition still retained its grease characteristics after a test period of 900 hours, at which time the grease sample still had grease-like characteristics, that is, the test sample after this time had not become hard or brittle. ■

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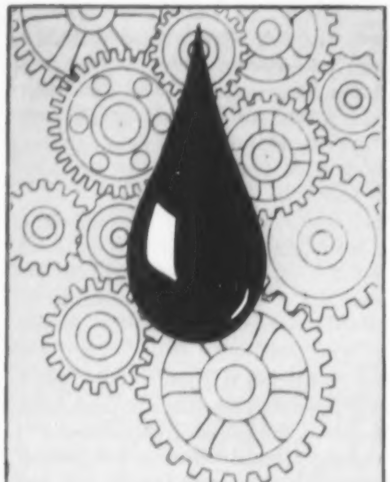

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National Lead's Finlayson Heads Bentone Sales

Baroid Division, National Lead company, has announced the appointment of C. M. Finlayson as manager of Bentone sales, effective January 1, 1957. Mr. Finlayson joined Baroid in 1946 and worked in the Mellon Institute on the development of Bentone. He has since been engaged in marketing Bentone products. Presently residing in Fredonia, Pennsylvania, Mr. Finlayson will join the Baroid general offices at Houston in the early spring.

Morava Ascends to Presidency, U. S. Steel Supply Division

Appointment of John H. Morava as president of United States Steel supply division of the United States Steel corporation, effective February 1, was announced by Clifford F. Hood, president of United States Steel. The supply division merchandizes a wide variety of steel products through its eighteen warehouses throughout the country.

In the Southwest, U. S. steel supply warehouses are located in Houston and Dallas.

Mr. Morava succeeds Leslie B. Worthington who was recently made president of the Columbia-Geneva steel division in San Francisco. He moves to his new post from the position of manager of sales of United States Steel's Chicago district sales office.

E. J. Griffin Dies; Was Shell Executive

E. J. Griffin, sales assistant to the vice president of Shell Oil company's West Coast marketing division, died February 1 in the San Rafael, Calif., hospital after a brief illness.

Griffin, 48, was a native of Butte, Montana. After attending Montana State School of Mines and the University of Washington, he joined Shell in Butte in 1930. He later served as division sales manager in Salt Lake City and Los Angeles.

During World War II he was a captain in the Army transportation corps in charge of gasoline supplies for all ground forces in the European Theatre.

In 1949 Griffin was made assistant to the general sales manager in San Francisco. In 1951 he was promoted to the post of manager of the Cleveland, Ohio, marketing division, and in 1954 he was made assistant to the marketing vice president in New York. He was appointed to his most recent position in 1955.

Bray Oil Names Connelly Division Sales Manager

The appointment of Robert F. Connelly as sales manager of the aircraft and chemical division of Bray Oil company is announced by Dr. Ulric B. Bray, general manager. He will serve as a specialist in lubrication, corrosion, and hy-

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Mr. Connelly obtained his B. S. degree from the California Institute of Technology: he is secretary-treasurer of the Los Angeles section of the American Society of Lubrication Engineers, a member of the National Association of Corrosion Engineers, the Society of Aircraft Materials and Process Engineers, the American Chemical Society, and the American Institute of Chemists.

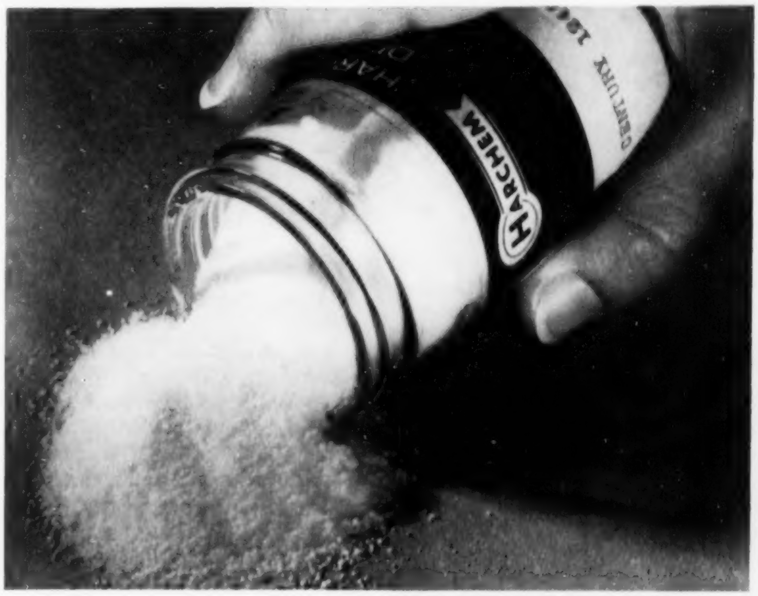
Mr. Connelly served as research chemist for the Bray Oil company developing lubricants, hydraulic fluids, and corrosion preventives over a period of four years. He returns to Bray after association with the organic chemical department of Emery Industries, Inc., Cincinnati, Ohio.

Acheson Elects Clarke Vice President

Because of the rapid expansion of European industrial production, which has greatly increased the demand for its products abroad, Acheson Industries, Inc., New York, has created a new position, vice-president in charge of European operations. Edwin G. Clarke, formerly managing director of Acheson's British affiliate, Acheson Colloids, Ltd., has been elected to the new post, Howard A. Acheson, president, has announced. Mr. Clarke, who has played an important part in the growth of the British and European business, has also been elected a director of Acheson Industries, Inc.

Acheson Industries, Inc., is the parent organization for a number of subsidiaries which already operate both in the U. S. and Europe. In the United States, Acheson Colloids Company Division, Port Huron, Michigan, manufactures 'dag' brand colloidal dispersions of graphite, copper, molybdenum disulfide, mica, vermiculite and zinc oxide, in a wide range of liquid carriers. Other units of Acheson Industries, Inc., in the United States include: Acheson Dispersed Pigments Co., Philadelphia, Pa., producers of ink bases, special purpose inks, and dispersions of carbon black and pigments for the plastics industry; and Gredag, Inc., Niagara Falls, N. Y., which markets graphited and specialty greases.

Continued on page 42



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ASLE Appoints C. L. Willey Executive Secretary

The board of directors of the American Society of Lubrication Engineers announce the appointment of Mr. Calvert L. Willey as administrative secretary for the society.

Mr. Willey was formerly associated with the National Society of Professional Engineers as assistant to the executive director.

A business and public administration graduate of the University of Maryland, Mr. Willey served with the U. S. Navy for six years as a general line officer. Upon release to inactive duty in 1952 he assumed a position with a management consulting firm engaged in a naval personnel research contract for the Office of Naval Research, Department of the Navy.

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Aro Names Moore Manager Lube Equipment

The Aro Equipment corporation of Bryan, Ohio, manufacturer of lubricating equipment, has promoted William H. Moore to field service manager of the Arolube division. His department will be responsible for establishing and maintaining all field service and installation facilities for uses of the company's lubricating equipment. He will report directly to C. A. Stutzman, manager of the Arolube division.

Mr. Moore was born in Bryan, Ohio, in 1923. After graduation from high school in 1941 he joined Aro as a machinist. In March, 1943, he entered military service and was assigned to the 27th Infantry division. During 30 months in the Pacific theater he was in Hawaii, the Gilberts, Marshalls, Marianas, New Hebrides, Okinawa and Japan. He was also in the invasion forces which landed on Makin, Saipan and Okinawa.

Returned to Aro's Factory Service

After his discharge from the service late in 1945, he returned to Aro and entered the factory service department. A year later, he transferred to the office service department, and in 1950 he became service manager. In the summer of 1952, he was transferred to the lubricating equipment sales department to apply his specialized training to field service development. He held this assignment until his recent promotion.

Du Pont Advances Four

James G. McIlhiney has been made a district manager in the Du Pont Company's petroleum chemicals division. He will take over the newly created Denver district.

Mr. McIlhiney comes to his new post from Philadelphia where he was a salesman of petroleum additives. A mechanical engineering graduate of Cornell University, he joined the Du Pont company in 1947 and has been a sales representative to the refining industry on both the East and Gulf coasts. He also served for a year in the new product development group in the Wilmington office.

Mr. McIlhiney's district consists of North Dakota, Montana, Wyoming, Colorado, New Mexico, the county of El Paso in Texas, and the western parts of South Dakota and Nebraska.

Wingate Is Assistant Manager

These new appointments have been announced for Du Pont's petroleum chemicals division by David H. Conklin, director of sales.

William W. Wingate has been promoted to assistant manager of the Mid-Continent region, replac-

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ing Barrett B. Russell who has been named assistant manager of the Gulf Coast region, with headquarters in Houston. Richard O. Braendle, who has been assistant to the additives sales manager in Wilmington, has been assigned to Mr. Wingate's former post of additives manager for the Mid-Continent region.

Mr. Wingate, who has been with the Du Pont company since 1941, worked with the oil industry as a sales representative in the Eastern and Gulf Coast regions of the division and later contacted refiners in new product development work while headquartered in Wilmington. He is a chemical engineering graduate of the University of Pennsylvania.

Mr. Russell, a graduate of the Massachusetts Institute of Technology, has been a petroleum chemicals division sales supervisor in the Central region and was assistant to the sales manager and additives sales coordinator in Wilmington. He worked on processes for catalytic cracking of gasolines, special lubricants and jet fuels for the Standard Oil Development company before joining Du Pont in 1950.

Mr. Braendle has worked in the field of petroleum additives since 1949; he joined Du Pont in 1944. A chemical engineering graduate of the Massachusetts Institute of Technology, he contacted the oil industry through his work in market development of new products for the petroleum chemicals division.

Sharpe is New Socony Chief Engineer

Robert Q. Sharpe, staff engineer of the industrial division of the lubricating department at Socony Mobil Oil Company, Inc., New York, has been appointed chief engineer of the department.

Mr. Sharpe, a mechanical engineer and a graduate of the University of Kansas, joined Socony Mobil in 1942 as a lubricating engineer. He is a native of Neodesha, Kans.

In his new assignment Mr. Sharpe succeeds Mr. A. C. Stutson who has been named assistant manager of publications and training for the department.

Mallinckrodt Promotes E. R. Kuehne

The appointment of E. Richard Kuehne as regional sales manager was announced by W. S. Keutzer, western division sales manager, Mallinckrodt Chemical works, St. Louis.

Kuehne has served as Chicago district sales manager for Mallinckrodt since 1954. In his new appointment he will have the additional responsibility of supervising sales activities in Minnesota, North Dakota and South Dakota.

Kuehne joined Mallinckrodt in 1943 as a sales representative in the Chicago area. In 1951 he was appointed assistant district sales manager. Before coming to Mallinckrodt he was a Chicago salesman for the Pure Oil company.

Batelle Elevates Goldwaite and Fawcett

William H. Goldthwaite has been appointed chief of the engineering mechanics division at Battelle Institute. In this position he will direct research dealing primarily with mechanics, heat, friction, and wear. One of the major phases of the division's research involves the design of bearings and other mechanical components for operation at extremely high temperatures and in unusual liquid and gaseous environments.

Goldthwaite joined Battelle in 1951 after receiving his M.S. degree in physics at the University of New Hampshire. He received his A.B. degree from Middlebury college in 1949. Since he has been at Battelle,

Continued on page 44

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Goldthwaite has participated in the development of components for nuclear reactors, including bearings, valves, pumps, and seals. He has also carried out heat transfer studies for nuclear reactor components and has been associated with the design and evaluation of bearings for use in jet aircraft, rockets, and reactors.

Dr. Sherwood L. Fawcett has been appointed assistant manager of the department of physics at Battelle Institute. In announcing the appointment, Dr. H. R. Nelson, manager of the physics department, stated that Fawcett, a specialist in nuclear engineering and heat transfer, will direct much of his time to expanding the activities of the department.

Prior to assuming his present post Dr. Fawcett served as chief of Battelle's engineering mechanics division. He is coauthor of numerous articles and reports dealing with such nuclear physics subjects as heating methods for thermal-rupture tests of ceramic fuel elements, and measurement of nuclear reactor heat-transfer coefficients. Fawcett received his B.S. degree from the Ohio State University in 1941, having majored in engineering physics. He carried out his graduate studies and research at Case Institute of Technology, from which he received his M.S. degree and, in 1950, his Ph.D. in physics. During his last two years at Case he held a U. S. Atomic Energy commission predoctoral fellowship. Dr. Fawcett is a member of the nuclear engineering division of the American Institute of Chemical Engineers, the American Physcial Society, Sigma Xi, and Tau Beta Pi.

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Almost everything that moves either in actual operation or in the process of its making . . . from gate hinges to tractor wheels . . . depends upon grease. That is why lubricants should be bought with care. You can always depend upon Deep Rock highest quality greases and lubricants. They are manufactured to give **top lubrication to all moving parts.**

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Dr. F. W. Breth, Sonneborn Technical Director, Dies

Dr. Ferdinand W. Breth, vice president and technical director of L. Sonneborn Sons, Inc., New York, N. Y., petroleum refiners and manufacturing chemists, died January 8 of a heart attack while en route to a New York Hospital. His age was seventy.

A native of Bohemia, Dr. Breth joined the Sonneborn organization in 1915, established a research laboratory at the firm's Nutley, N. J., manufacturing plant and remained there for five years as director of research. He then transferred to Sonneborn's refinery at Petrolia, Pa., and there established and directed one of the early petroleum research laboratories. A few years following, he established similar research factilities at another refinery which Sonneborn acquired at Franklin, Pa. Functioning as vice president and research director, he had divided his time for approximately the last 20 years between the Sonneborn refineries and the firms's main offices in New York City.

Dr. Breth was a member of the American Chemical Society, the American Society for Testing Materials and the Chemists club. In association with others, he received several U. S. patents, the better known of which were for the discovery that activitated bauxite was an ideal decolorizer for petroleum products; and for the development of one of the earliest known pour point depresants for motor oils.

Leech Services Mid-Atlantic Accounts

Emery Industries, Inc. has appointed Paul N. Leech sales representative in the Mid-Atlantic territory, according to G. W. Boyd, sales manager of Emery's fatty acid sales department.

Leech's appointment is another

Continued on page 45

SWIFT'S
INDUSTRIAL OILS INVITE COMPARISON

Write for a trial order of any of these Swift quality products . . . a trial in your own shop will convince you of their stability and dependability in helping to produce lighter, more uniform lubricants.

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Swift & Company
INDUSTRIAL OIL DEPT.
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Industry NEWS

ASTM Standards on Petroleum Products and Lubricants Released

This special compilation prepared by ASTM Committee D-2 includes tentative and standard methods of test, specifications, definitions of terms and classifications of petroleum products and lubricants with related information, including the report of Committee D-2 on petroleum products and lubricants, and proposed methods of test.

This book has been published annually since 1927; the present edition includes 180 standards, 48 of which are new or revised since the previous edition.

Some of the new standards are methods of test for: tetraethyllead in gasoline, D 526; evaporation loss of lubricating greases and oils, D 972; mercaptan sulfur in jet fuels (color-indicator method, D 1219) (amperometric method, D 1323); and analysis of calcium and barium petroleum sulfonates, D 1216.

Methods for Tank Calibrations

Among the new tentatives are five methods for calibration of tanks (D 1406 through D 1410) and tentative methods of test for: emulsion characteristics of steam turbine oils, D 1401; effect of copper on the oxidation rate of grease, D 1402; estimation of heat of combustion of liquid petroleum products, D 1405, and many others.

Copies may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $7.50 each for the cloth covered edition or $6.75 each for paper covers.

Leech Services Mid-Atlantic

Continued from page 44

move in Emery's expansion program initiated last when separate sales departments were established for fatty acids and organic chemicals in order to provide better, more specialized service in each field.

Leech's territory includes central and northeastern Pennsylvania, northern New Jersey, western Maryland, and central New York State. He will be responsible for the sale of Emery's complete line of fatty acids, including stearic and oleic acids, hydrogenated acids and glycerides, animal and vegetable fatty acids, and castor oil derivatives.

Prior to joining Emery, Leech was a sales representative for M & R Dietetic laboratories, in the greater Toledo area. He holds the degree of B. S. in chemistry from Northwestern university and is a member of the American Chemical Society.

Trabon Engineering Expands; Doubles Previous Quarters

Seventeen miles from downtown Cleveland is Trabon Engineering's new plant site and office buildings, an increase of fifty per cent over previous quarters.

Trabon specializes in modern centralized lubricating systems—invented and developed during the thirties and proven during World War II.

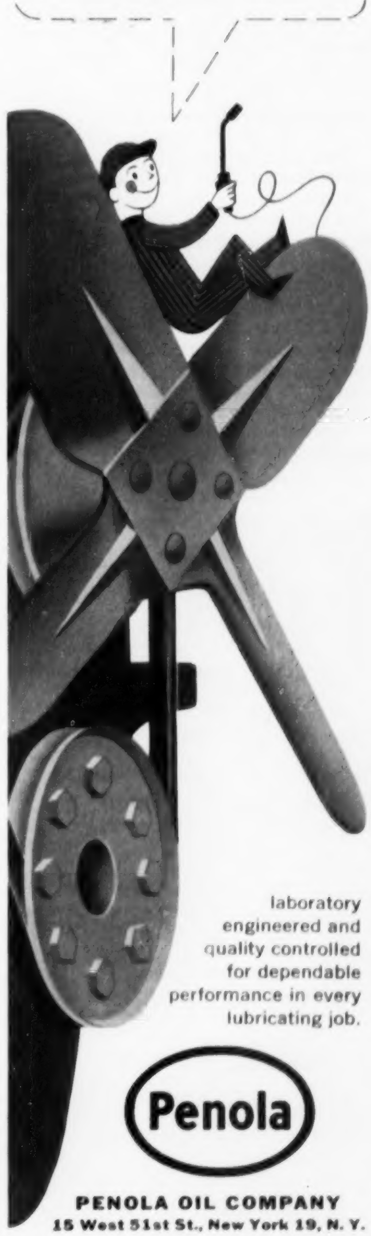
Trabon's patented progressive feeder operation makes it impossible to skip or underlubricate a bearing with pressures of 2000 psi and higher, according to company reports.

Primarily, Trabon manufactures oil and grease pumps and steel metering valves in addition to several thousand accessory items used in the installation of centralized lubricating systems.

Sales are principally handled through independent distributors and agents located in over thirty cities throughout the United States, as well as representatives in Canada and Mexico and other foreign countries. *Continued on page 48*

for top protection, always specify

PENOLA AUTOMOTIVE LUBRICANTS



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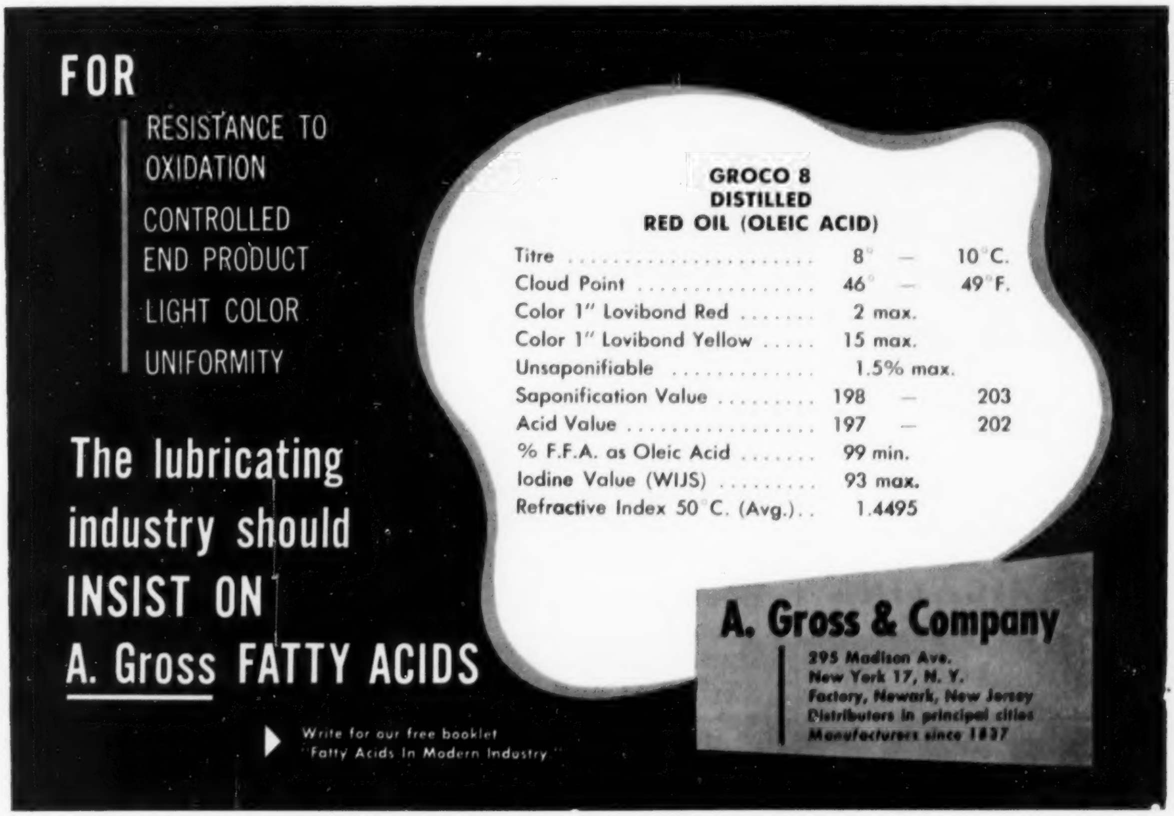

American Potash Expands Research Laboratories In Whittier

A $200,000 addition to American Potash & Chemical Corporation's Whittier (Calif.) research laboratory was opened recently as part of the company's expanding research program.

The new addition, which doubles previous workroom space, consists of three four-man labs, two three-man labs, a small lab for micro-analytical work, two large labs for process development and other rooms for allied uses.

In line with AP&CC's expanding research activities, personnel at the company's Whittier facility has more than doubled since the lab was opened three years ago. With less than 30 employees in 1953, the lab now has a staff of 65 under the direction of Dr. William Emerson.

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NEWARK, N. J.

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Manufacturers of

LUBRICATING GREASES

General Cooperage Moves

General Cooperage company has moved its offices and plant to new and larger facilities at 2435 Island Road in Philadelphia 42, Pennsylvania. The company was formerly located at 434-436 North Third Street in Philadelphia.

General Cooperage principally reconditions steel shipping containers.

Du Pont Studies Motorists' Attitudes

A psychological study of factors that determine motorists' attitudes about service stations and the products they sell has been completed for Du Pont's petroleum chemicals division.

The survey, which is expected to be useful to oil companies in their advertising and marketing programs, results from 2,036 separate interviews with drivers representing an economic and geographic cross section of the country. It is based on the premise that the driver is predisposed to follow certain buying patterns, depending on his mental concept of a service station. This concept is determined by his personality needs and the forces that motivate him while he is driving a car. Added to this is the concern he has about the quality of products and services offered at a service station. This concept, or mental image, also may be affected by family influence, past experience with service stations, and oil company influence.

An Eastern grease manufacturer is desirous of buying a used or reconditioned Ross Conical Burr Stone Mill, style 1; size 4; vertical type; with gear drive.

Adaptable for grinding lubricating greases—reply to NLGI Spokesman, Box M-1.

United Petroleum Heralds New Company Name, McCollister Grease & Oil

The United Petroleum corporation, grease manufacturers, and oil compounders of Omaha, Nebraska, recently announced a change in the name of their company to the McCollister Grease & Oil corporation.

Mr. John M. McCollister, president, advised that the change in name was brought about by a steady increase in custom, private label, manufacturing and packaging of greases and oils.

In the future, only United branded products will be sold by the United Petroleum corporation which was organized as a subsidiary company of McCollister Grease & Oil corporation.

Principal officers remain unchanged, John M. McCollister continues as president, and two sons, John Y. McCollister and Howard R. McCollister remain as vice-presidents.

McGEAN 30% LEAD NAPHTHENATE ADDITIVE

Consistently uniform in metallic content and viscosity

Fully clarified by filtration

Non-Oxidizing - - - contains no unsaturated soaps

Free from low flash constituents

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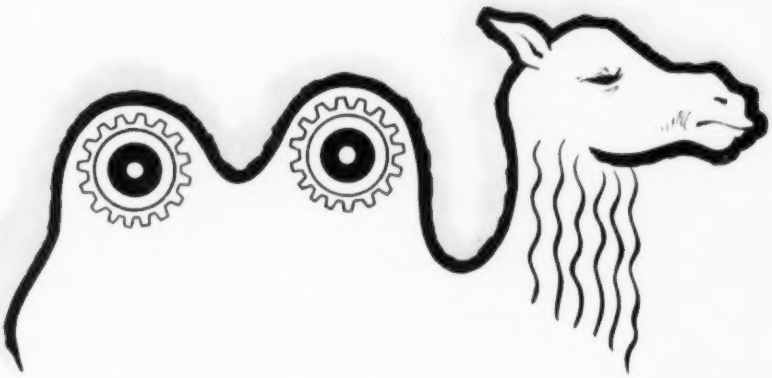

Lithium-Base Multi-Purpose

INLUCITE 21
OUTLASTS

**Ordinary Greases
5 to 10 Times**

INLUCITE 21 won't wash out . . . won't squeeze out . . . won't melt out . . . it absorbs more moisture, actually "stays put" longer, giving you extra hundreds of miles of protection and worthwhile savings in maintenance costs. You save time, labor and expense when you use INLUCITE 21, the unexcelled "one grease-one gun" lubricant that outlasts every specialized grease it replaces!

INTERNATIONAL LUBRICANT CORP.

NEW ORLEANS, LOUISIANA

Manufacturers of Quality Lubricants • AVIATION • INDUSTRIAL • AUTOMOTIVE • MARINE

With Research Comes Quality, With Quality Comes Leadership

GODFREY L. CABOT, Inc., Boston, Massachusetts, chemicals manufacturer since 1882 and today world-wide in operation, offers among its most popular white minerals and chemicals a unique silica pigment, Cab-o-sil, and a calcium metasilicate called Wollastonite. As world's only manufacturer of a complete range of channel, furnace and thermal blacks, Cabot continues to maintain its carbon black leadership while extending that leadership to other fields.

Cab-o-sil is the trade name for a silica pigment prepared in a hot gaseous environment by the vapor phase hydrolysis of a silicon compound—a method which makes it entirely different from other commercial siliceous pigments. It has proved effective, often in amazingly small quantities, in the rubber, paint, plastics and many other of the nation's leading industries. The potential use value of Cab-o-sil in greases is already being evaluated, both in the Cabot laboratories and in industrial laboratories throughout the country, and its unique high thickening efficiency holds great future promise for this industry.

Helping with the market development of this new silica pigment is Cab-o-sil product manager, Henry P. Donohue, Jr. Mr. Donohue, who serves as NLGI company representative, joined the Cabot Boston research and development laboratories in 1952 as a junior chemical engineer with the applied research section. A graduate of Tufts university, he had just concluded two years of service as an engineering officer with the U. S. Navy. He had previously worked as a field engineer with the Norcross corporation, manufacturers of viscosity control instruments.

After joining Cabot, Mr. Donohue was assigned to work on new white pigment pilot plant projects. In January, 1954, he became a member of a special market research and development group working with and under the personal supervision of the director of the Boston research and development laboratories. In August, 1955, he was appointed to the Cabo-o-sil sales staff, and has recently been named product manager, coordinating all technical sales service and continuing to develop new Cab-o-sil markets.

On the research staff for Cab-o-sil is Peter Marsden, NLGI technical representative. Mr. Marsden came to Cabot in 1955 with experience in a number of British and American companies. He attended London university, and then joined Imperial Chemical Industries Limited to do work on acrylic polymers and polymerization catalysts. He went on to Pinchin, Johnson Associates for a year of research on alkyd resins, and then joined Secomastic Limited where he was made chief chemist in charge of research on caulking compounds and other building materials.

Mr. Marsden came to the United States in 1952 to become technical director of Landen Putty works in Malden, Massachusetts, and upon leaving this position, served for two years as president of the Sealube company in Wakefield, Massachusetts, manufacturers of specialty greases and protective coatings. He joined Cabot as consultant on caulking and glazing compounds and was then appointed a permanent member of the pigments applications staff. Mr. Marsden now devotes his full time to research on Cab-o-sil in greases.

Also of interest to the grease industry is Vulcan XC-72, the highly conductive furnace carbon black just introduced by Cabot in commercial quantities. The effectiveness of the exceptionally high thickening and oil absorption characteristics and excellent thermal stability of this new black has already been shown in silicone oil-based and petroleum-based greases. The outstanding properties of Vulcan XC-72, combined with its inherent low cost suggest its application in the grease industry wherever high temperatures and pressures are a problem.

In addition to carbon blacks and its new white pigments, Cab-o-sil and Wollastonite, Godfrey L. Cabot, Inc. manufactures a number of other products, including plasticizers, pine products, charcoal, natural gas, natural gasoline, oil, oil well drilling, servicing and pumping equipment and gun tubes.

NEW MEMBER

Godfrey Cabot Joins NLGI

Company Representative
Henry Donahue, Jr.

Technical Representative
Peter Marsden

AT FOOTE the LITHIUM story is 450 feet long

The country's most exhaustive collection of printed material on lithium—its characteristics, compounds, and applications—rests on 450 feet of library shelving at Foote Mineral's Berwyn Research Library. Here is the up-to-the-minute historyof lithium . . . indexed for immediate access to any one of 13,000 references which chemically, physically, and metallurgically describe this most unusual of all metals. Begun more than a quarter century ago when Foote pioneered in the development of lithium, it is still growing at the rate of well over a foot of library shelf a week.

What does this mean to you? Well, lithium and its compounds in a very few years have outgrown the laboratory curiosity stage to become important factors in chemistry . . . ceramics . . . greases . . . organic intermediates . . . nuclear energy . . . to name but a few. Chances are that in the next five years you'll be investigating lithium as it might apply to your field. But when you do . . . before you invest time, effort, and money . . . your ideas will be thoroughly researched in this immense accumulation of data, by men who have played an important part in discovering the facts and creating the literature.

• • •

Write for *Chemical and Physical Properties of Lithium Compounds* and a taste of what Foote's store of lithium information has to offer you. This Data Bulletin is available on request to the Technical Literature Department, Foote Mineral Company, 402 Eighteen West Chelten Building, Philadelphia 44, Pa.

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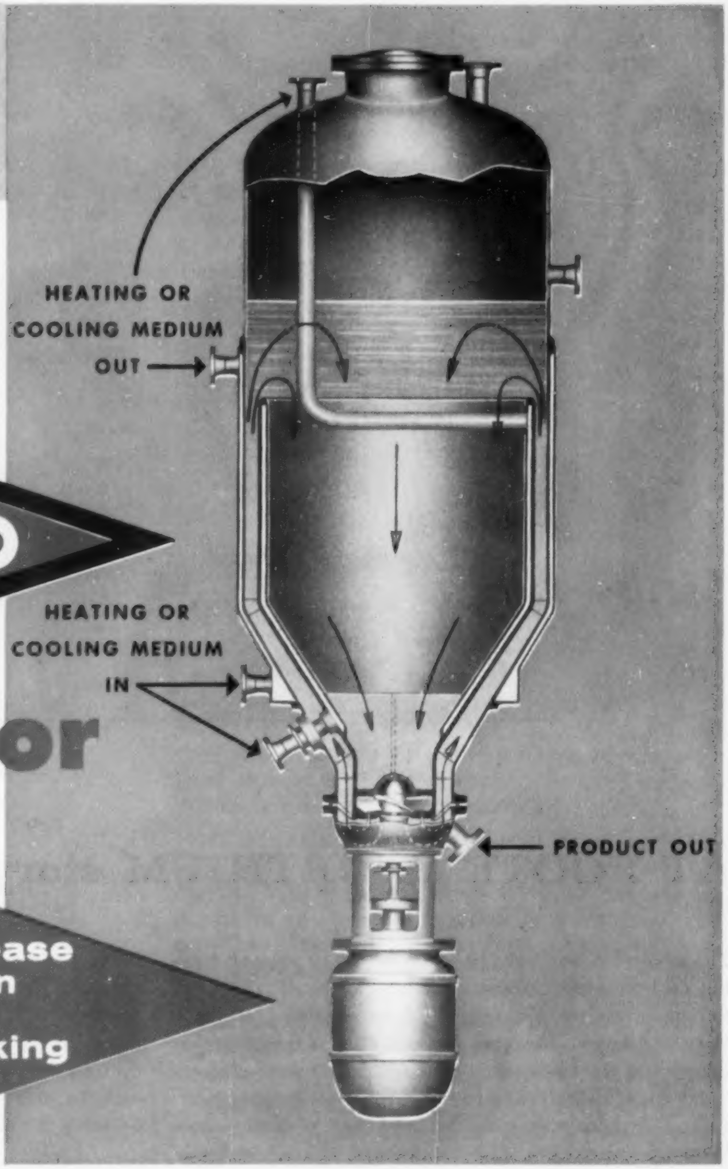
Reg. U. S. Pat. Off.



• Will Simplify Your Grease Plant Operation
• Reduce Your Grease Making Costs

The Stratco Contactor provides complete saponification of all soaps with very short time cycles and with resulting less soap requirement, simplified laboratory control and reduced man hours of operation.

It can be used for either batch or continuous mixing. It is adaptable to existing plants as basic equipment in a modernization program, or to completely new installations as a vital and money saving unit, regardless of other equipment used.

This contactor also is employed advantageously in clay contacting and in sulphurization of cutting oils. It is available in capacities from 2 gallon laboratory units to 2300 gallon commercial sizes.

STRATFORD ENGINEERING Corporation

612 West 47th St. — *PETROLEUM REFINING ENGINEERS* — Kansas City 12, Mo.